11 MAY 1945

The QUARTERLY BULLETIN

MICHIGAN STATE COLLEGE
Agricultural Experiment Station
EAST LANSING - - - - - - - - MICHIGAN

VOLUME 27 - - FEBRUARY 1945 - - NUMBER 3

CONTENTS

PAGE

DANGERS OF THE HOME-BUILT ELECTRIC FENCE CONTROLLER...*by D. E. Wiant* 261

TRACING THE CAUSES OF OFF-FLAVORS IN MILK: A GUIDE...*by G. M. Trout* 266

MANAGEMENT IN MICHIGAN HOMES.....
.....*by Irma H. Gross and Evelyn A. Zwemer* 273

PULLORUM DISEASE, ITS NATURE AND ITS CONTROL.....
.....*by H. J. Stafseth and C. W. Darby* 282

AN INEXPENSIVE HOME-MADE BEESWAX PRESS.....
.....*by R. H. Kelty and Walter Sheldon* 292

VACUUM-TYPE HARVESTER FOR WHITE CLOVER SEED.....
.....*by S. T. Dexter and E. G. McKibben* 294

REGENT WHEAT FOR THE UPPER PENINSULA.....
.....*by J. G. Wells, Jr., D. L. Clanahan, and B. R. Churchill* 298

SOME NEW IDEAS IN WEED CONTROL.....
.....*by Buford H. Grigsby and Keith C. Barrons* 301

PRELIMINARY RESULTS OF ARTIFICIAL INSEMINATION THROUGH A COOPERATIVE ENTERPRISE.....*by W. W. Snyder and A. C. Baltzer* 310

(Continued on Next Page)

V. R. GARDNER, Director - - - - - - - J. G. DUNCAN, Editor

THE QUARTERLY BULLETIN

The Quarterly Bulletin of the Michigan Agricultural Experiment Station is issued in February, May, August and November. It presents: (1) progress reports on long-term major research projects, (2) final reports on short-term projects and (3) short, timely articles of a popular nature that bring together information from various sources on subjects in which farmers are interested.

CONTENTS

(Continued from Outside Cover)

PAGE

COMPARISON OF HOMINY FEED AND GROUND YELLOW CORN IN A BROILER RATION.....*by J. A. Davidson, C. M. McCrary, and C. G. Card* 313

SPRING WHEAT AT EAST LANSING, MICHIGAN.....*by Hubert M. Brown* 320

EFFECT OF SNOW-ICE ON THE RETENTION OF VITAMIN C IN GREEN VEGETABLES DISPLAYED IN A RETAIL MARKET.....*by Lois Gordon, Ruth M. Griswold, and Thelma Porter* 322

THE AGRICULTURAL VENEER CONTAINER INDUSTRY IN SOUTHERN MICHIGAN .....*by R. C. Johnson* 328

EMULSIONS FOR HORTICULTURAL SPRAYS.....*by E. J. Miller, A. L. Neal, and V. R. Gardner* 338

THINNING APPLES WITH THE SODIUM SALT OF NAPHTHYL ACETIC ACID.....*by J. H. Davidson, O. H. Hammer, C. A. Reimer, and W. C. Dutton* 352

AN EXPERIMENT IN THE PLACEMENT OF ORCHARD FERTILIZERS.....*by T. A. Merrill and Guy Springer* 357

LACTIC ACID AND TITRATABLE ACIDITY OF COMMERCIAL DRIED AND EVAPORATED MILK IN MICHIGAN.....*by I. A. Gould and F. M. Skiver* 360

MOW DRYING OF HAY.....*by S. T. Dexter and W. H. Sheldon* 365

BULLETIN REVIEW 371

JOURNAL ARTICLE ABSTRACTS 372

DANGERS OF THE HOME-BUILT ELECTRIC FENCE CONTROLLER

By D. E. WIANT
SECTION OF AGRICULTURAL ENGINEERING

THE PRACTICE of energizing wire fences by connecting them to the ordinary lighting circuit* with a home-built contrivance is dangerous, even deadly. No one who is fully aware of the hazard such a fence represents will sanction its use. The purpose of this article is to show how and why such a fence is dangerous.

The home-built controller is usually made up somewhat like the one shown in Fig. 1. It consists of a two-prong plug, a socket, a lamp, and whatever wire is necessary. This contrivance is plugged into any convenient outlet and connected to the fence. Sometimes another socket is added between the lamp and the plug and a small (one-ampere) fuse is placed in this socket. Occasionally, two small fuses are used, one on either side of the lamp. The size of the lamp used varies from 7½ to

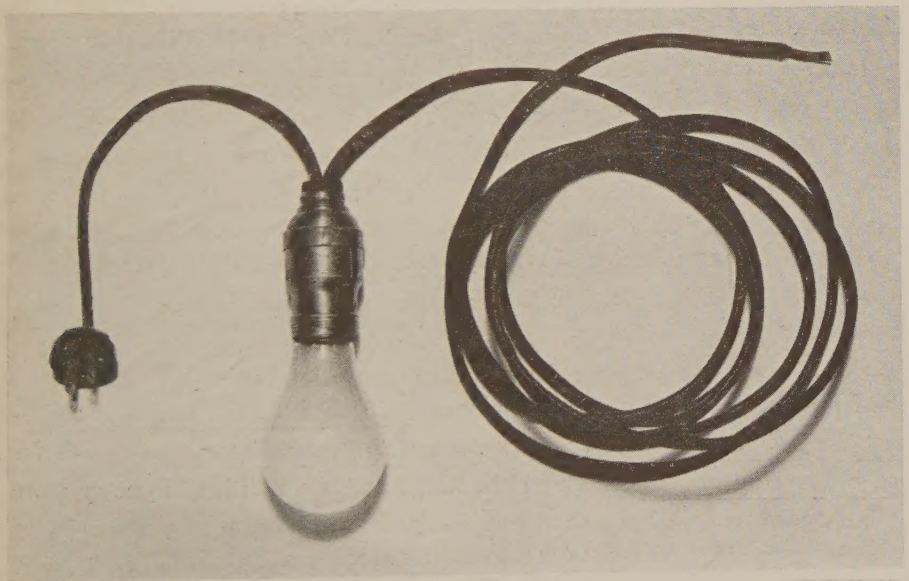


Fig. 1. A typical home-built electric fence controller. This contrivance makes a death trap out of a fence.

*Practically all rural lines transmit alternating current.

60 watts, and the use of 100-watt lamps has been reported. It is customary to use the lamps of the higher wattages mentioned when the ground is dry.

There are two serious objections to the use of the type of equipment just described. When the ground is dry the fence is not effective. When the ground is damp, this type of fence is dangerous to man and beast. It may be dangerous even when the ground is dry. The voltage of the ordinary lighting circuit is 110 to 120 volts. This voltage is not sufficient to overcome the resistance of dry ground; hence, when the ground is dry the fence is ineffective. Commercially made controllers utilize transformers to step up the voltage to 800, 1,000, or even higher.

A fence energized through a home-made controller is dangerous to man and animals when the ground is damp or wet for two reasons: the amount of current (amperes) that will flow through even a 7½-watt lamp is 10 times as great as is considered safe, and the current, being continuous, does not give the victim who has touched the fence an opportunity to break away. The effects of shock by low voltage current are to contract the muscles and render the victim helpless. Neither the Industrial Commission of the State of Wisconsin nor the Underwriters Laboratories, Inc.,* will approve any type of controller which supplies a continuous current to a fence.

From a series of tests conducted upon 134 physically sound men and 28 physically sound women at the University of California,** the conclusions were made that:

1. A reasonably safe electric current for normal healthy adults is the "let-go" current which 99½ percent of a large group can release by using muscles directly affected by that current.
2. The reasonably safe 60-cycle current for most normal healthy adult men is about 9 milliamperes; the reasonably safe 60-cycle current for most normal healthy adult women is about 6 milliamperes.

A 7½-watt lamp in the home-built controller limits the current to the fence to approximately 62 milliamperes. *Thus, it can be seen that a 7½-watt lamp allows 10 times as much current to flow as is reasonably safe for normal healthy women.* It should be noted that the addition of one or more one-ampere fuses is a futile attempt at precaution because a one-ampere fuse allows 1,000 milliamperes to flow through a circuit. It would be

*A function of these two boards is to test and approve or reject electric fence controllers. The testing is done purely in the interest of safety. In Oregon the State Electrical Inspector must approve electric fence controls before they can be sold in that state. Every home-built controller would have to be tested, a procedure which would be impractical.

**"Effect of Frequency on Let-Go Currents," July 1943, paper by C. F. Dalziel, University of California; Eric Ogden, University of Texas; and Curtis E. Abbott, University of California at AIEE national technical meeting, Salt Lake City, Utah, September 1943.

necessary to connect ten 7½-watt lamps in series (one after the other) to limit the current to a safe value. It would require eighty 60-watt lamps to limit the current to a safe value. Such a controller then, although it would limit the current to a safe value, would not supply sufficient voltage to restrain livestock.

From the paragraph above it can be seen that to build a safe, effective controller requires more than just lamps for a current-limiting device, and requires the technical knowledge found in the carefully trained electrical engineer. Some of our manufacturers of radio equipment worked five years or longer on alternating current fence controllers before putting them in the hands of the user. Several years ago several state colleges furnished plans for building battery operated fence controllers. Subsequent checks failed to find any of these home-made controllers that had given satisfactory service for as long as six months.

MICHIGAN LIVESTOCK LOSSES DUE TO HOME-BUILT CONTROLLERS

The amount of livestock killed in Michigan indicates the hazards of the home-built controller. Fig. 2 shows the effectiveness of a home-built controller as a killer.

Fig. 2. This shows what a home-built controller will do. The farm wife who tried to save the heifer lost her life on the fence.
(Photograph: Michigan State Police)

The following quotations are taken from letters received from rendering plants in Michigan, in reply to our request for information regarding the number of animals killed by home-built controllers.

"Answering your letter regarding Michigan State College's inquiry, sorry to report that we have no record of the number of animals killed by electric fences. However, there are very many cases where animals are killed by home-made controllers. I have thought for a long time that some action should be taken by the state to eliminate dangerous home-made controllers, especially when they are liable to kill a person instead of an animal."

"We can readily understand the need for some publicity or education throughout some of the rural districts and the cautioning against the use of some inefficient and home-made controllers."

"The figures below are estimated to the best of our knowledge as we do not keep a record of such deaths.

"Three-year total: 3 horses, 8 cows, 25 hogs."

"In replying to your letter . . . we have been picking up approximately 10 cows, 15 horses, 5 pigs . . . per year since around 1940 that were alleged to have been killed by electric fences. I have obtained these estimates from our three pick-up men."

The majority of Michigan rendering plants stated that they kept no record of cause of death of animals received.

DEATHS FROM ELECTROCUTION BY HOME-BUILT CONTROLLERS

Within a period of a few months last year three Michigan residents were electrocuted by coming in contact with fences energized by home-made electric fence controllers. A farm wife who presumably attempted to rescue the heifer shown in Fig. 2 was found dead on the fence. The controller was equipped with a 60-watt lamp. Another electrocution took place in southern Michigan. Two boys while hunting frogs came across an electric fence. One of the boys crawled under the fence at a dry spot and then went back to the fence at a wet place to show his companion that the fence wasn't charged. He took hold of the wire with both hands, "froze" to the wire, and death resulted. This fence was energized with a controller which used a 15-watt lamp to limit the current. At the inquest, the owner of the fence testified that he would not have thought of using such equipment on the place *if he had*

known it was dangerous. Recent publications* report deaths in other states as well as Michigan, but the story is the same: "A 7½-watt lamp was used to limit the current" or "The child instantly became frozen to the wire."

A student in one of the writer's classes remarked that his father used a home-built fence controller and "got caught" on the fence. Fortunately he was standing on dry ground and was able to break away from the fence. The controller was given to a neighbor who used it—until it killed his dog.

ELECTRIC FENCE A BOON TO THE FARMER

A good electric fence saves time, labor, and materials, all of which are critical at the present time. The value of the electric fence has been proved in all conservation practices.

SAFE ELECTRIC FENCE CONTROLLERS ARE AVAILABLE

Electric fence controllers approved by such organizations as the Industrial Commission of the State of Wisconsin and Underwriters Laboratories, Inc. are available. Controllers that have been approved are so marked. The use of an approved controller insures satisfactory operation and eliminates the hazards of the electric fence.

LEGISLATION AGAINST THE HOME-BUILT CONTROLLER

Use of the home-built fence controller, if continued, will bring about legislation which may be detrimental to the user of approved fence controllers.

It is the responsibility of those who know the dangers of the home-built alternating current fence controller to caution those who are not aware of the hazards involved in using such equipment.

**Electricity on the Farm*, Nov. 1944.
Our Line, Dec. 1944.

TRACING THE CAUSES OF OFF-FLAVORS IN MILK: A GUIDE

By G. M. TROUT
SECTION OF DAIRY

THE EXAMINATION for flavor of innumerable samples of milk has shown that certain understandings and techniques are helpful in diagnosing the contributing causes of off-flavors in milk. The literature reveals the fact that should a list of the off-flavors, tastes, odors or taints frequently encountered in milk be prepared, such a list would be so long that it would be baffling and confusing to the inexperienced in trying to trace them down and eliminate the cause of the defect. The causes of these many flavor defects may be classified on the basis of the distinguishing characteristics of each class, so that the field man, plant superintendent, or milk inspector may trace the defect to its source with a minimum of effort and time and with the assurance that the general cause of the trouble will be found.

Palatability of milk is one of the chief factors affecting consumption of milk and the one factor most often overlooked. The dairy industry is appreciating more and more that people drink milk regularly because they like it. It is hoped that the material presented herein, as briefly as possible, may be of value to those dairy plant workers and control officials, upon whom the responsibility for the maintenance of the good flavor of milk so largely depends.

DISTINGUISHING CHARACTERISTICS OF THE GENERAL CAUSES OF OFF-FLAVORS IN MILK

Although many groupings of the causes of off-flavors in milk have been suggested, the following classification, modified after that given by Hammer (1938) and by Sharp (1941), seems to be the most complete:

1. Bacteria growth,
2. Feed,
3. Absorbed,
4. Chemical composition of the milk,
5. Processing and handling,
6. Chemical changes (enzymatic and catalytic), and
7. Addition of foreign material.

(Article 27-29)

TABLE 1—*Distinguishing characteristics of off-flavors in milk resulting from specific causes*

Cause of off-flavor	Chief distinguishing characteristics of off-flavors in milk resulting from a specific cause
Bacteria growth	*Unusually high* bacteria count: 32,000,000 to 305,000,000 per ml. (Hammer and Hix, 1916) 1,300,000 to 160,000,000 per ml. (Gould and Jensen, 1944)
Feed	May be low-bacteria count; flavor present when milk is drawn; usually worse in night's milk; cows have had access to roughage too recently before milking; very pronounced odor.
Absorption Direct	Encountered very infrequently; results only after *long* exposure to *very* odoriferous atmosphere; odor *not* present when milk is first drawn.
Indirect, through cow breathing foul air	May be low-bacteria count; odor suggests uncleanliness; odor present when milk is first drawn.
Chemical composition of milk	Flavor defect is noticeable when the milk is first drawn; milk usually distinctly salty; inherent to individual animal, rarely in mixed milk; animal in advanced lactation or has infected udder.
Processing	Pasteurized, "heated" or modified "cooked" flavor. Detectable immediately after processing; usually not very intense; tends to disappear upon storage.
Chemical: Enzymatic and catalytic changes	Not present when milk is first drawn or pasteurized; develops readily at low temperatures—below 40° F.; low bacteria count; stored 24 to 72 hours. Three types: a. *Rancidity*—In *raw milk only;* bitter, soapy; defect worse in cream than in milk and more intense in butter than in cream. b. *Oxidized*—Chiefly in pasteurized milk; papery, tallowy. c. *Activated*—In pasteurized milk exposed to light; suggests burnt protein.
Foreign material	Defect present in freshly bottled product; rarely increases in intensity upon storage; taints varied as brine, medicinal, paint, fly spray, etc.

Each of these groups of causes of off-flavors has some distinguishing characteristics which aid in the identification or elimination of the source of the off-flavor. These characteristics, presented in Table 1, are well known by the milk judge who makes use of them regularly in diagnosing milk flavor defects.

SECURING CLUES TO THE POSSIBLE CAUSE OF MILK FLAVOR DEFECTS

If a milk flavor defect is to be overcome the cause of the off-flavor first must be sought. To this end the examiner attempts to seek the answer to a number of questions and, in general, in the following order:

1. What is the taste of the milk?
2. Are customer complaints occasional or general?
3. Is the milk raw or pasteurized?
4. Does the defect occur sporadically or has it persisted over an extended period of time?

5. Is the milk flavor defect present when the milk is first drawn?
6. How soon after production is the defect noted?
7. What is the bacteria count of the milk?
8. Does the defect occur in mixed milk or only in milk from an individual cow?
9. To what kind of roughage have the cows had access?
10. Has the milk come in contact with copper equipment?
11. Has the milk been held in the refrigerator more than 24 or 48 hours?
12. Has "every-other-day" delivery aggravated the problem?

In seeking an answer to these questions the examiner is mindful of the fact that (a) certain flavors are present only in raw milk—for example, rancidity; (b) that before bacteria bring about flavor changes their numbers must be in the millions per ml.; (c) that a sudden general outburst of flavor complaints usually indicates foreign contamination; (d) that a general increasing number of complaints over an extended period indicates an oxidized flavor; and (e) that flavors resulting from direct absorption are practically nil.

SEASONAL OCCURRENCE OF FLAVORS

A knowledge of the general occurrence of flavors throughout the year is very helpful to the plant men in seeking the cause of off-flavors. Certain flavors are particularly seasonal in their occurrence and are to be noted rarely during other seasons. The seasonal occurrence of some of the more troublesome off-flavors of milk are shown in Table 2. Here it will be noted that the oxidized flavor is strictly a winter or dry-feeding-period flavor defect. As soon as the cows are on pasture a short time the defect does not occur. Likewise, rancid milk is largely a late fall, winter, and early spring defect chiefly because at those times many cows are in late lactation. Also, salty milk will most likely be noted during those periods. Feed flavors are encountered chiefly during the early pasture season when cows are first turned to grass, rarely during the drying-pasture season, and again in the early fall when pastures once more have become succulent. Silage flavors are usually more pronounced in late winter when the barn may not be aired and when the silage is low in the silo and has a more intense odor.

TRACING THE FLAVOR DEFECT TO INDIVIDUAL COWS

Occasionally, it is highly desirable to taste milk from the individual animals in order to locate the contributing cause of the off-flavor. For this purpose approximately one-half pint samples of nights' and morn-

TABLE 2—*The period of the year when certain off-flavors of milk are more likely to be encountered*

Flavor defect	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Grassy					xxXXXXX	xxx . . .*			. . . xxxx	xxx		
Rye				XXXXXX	XX							
Silage	xxxxxxx	xxxXXXX	XXXXxxx	x							. . . xxxx	xxxxxxx
Alfalfa pasture							xxxxX	XXXXXXX	xxx . . .			
High-acid, sour					. . . . .	. xxxXXX	XXXXXXX	XXXXXXX	XXXxxxx	. . . . .		
Malty					. . . .	. . . xxxx	XXXXXXX	XXXXXXX	xxxxx . .	. . . . .		
Salty	xxxxxx	xxxxxxx	xx	. . . . .					. .	. . . . .	 x	xxxxxxx xxxxxxx
Barny	xxxxxxx	xxxxxxx	. . . . .							. . . . .	. . xxxxx	xxxxxxx
Rancid	xxxxxxx	xxxxXXX	XXxx . . .							. . . .	. . . xxxx	xxxxxxx
Oxidized	xxxxxxx	XXXXXXX	XXXXXXX	XXXXXXX	XX						. . . . .	. . xxxxx
Foreign	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .

*KEY: . . . . . flavor occurring occasionally or spotty.
xxxxxxx flavor occurring frequently.
XXXXXXX flavor most troublesome.

ings' milk from each cow are obtained. These samples should be marked so that the person judging them will have no knowledge of their identity. After having recorded his findings, the judge identifies the samples. Very often the trouble will be found to be localized in milk of a single individual.

If the mixed, raw milk becomes rancid upon standing, and it is desired to ascertain which animals yield milk contributing particularly to this off-flavor, these same samples may be held 24 to 48 hours at 40° F. or below and again tasted. By segregating milk known to be susceptible to the development of rancidity the flavor of the remainder of the milk will be very satisfactory so far as freedom from a rancid flavor is concerned. Usually, but not always, it is the milk from a cow far advanced in lactation and yielding only a small amount, that is responsible for the flavor defects. This is true of a salty taste, also. However, a salty taste may be noted in milk from a mastitis-infected udder regardless of the stage of lactation or of the yield.

TRACING THE FOCAL POINT OF COPPER CONTAMINATION IN A PLANT

When it has been definitely established that the defect is characterized by oxidized flavor, it is often necessary to locate the focal point of metal contamination or even the milk of one or more cows which is particularly susceptible to oxidation. The tracing of the metal contamination is done by taking samples all along the line of processing, using an *aluminum* dipper or *pyrex* beaker and collecting the sample in one-half pint milk bottles. Samples should be taken and numbered as follows:

Key*	No.	Source of sample	Flavor after 48 hours at 40° F.
G	1	Raw; from pasteurizing vat	
C	2	Pasteurized; directly from vat	
F	3	Pasteurized; at spreader pipe, top of cooler	
B	4	Pasteurized; at bottom of cooler	
E	5	Pasteurized; at bottler, supply tank	
A	6	Pasteurized; from bottler, supply tank	
D	7	Pasteurized; the bottled product	

*Samples are to be keyed by some person other than the one judging the milk. The one given is merely a suggestion.

At the end of 48 hours the samples may be examined and the flavors recorded on a separate sheet after which identification may be made by writing in the flavors on a table such as the one just given. It is often desirable to record the intensity as well as the presence or absence of oxidized flavor and for this purpose the following guide has been found very satisfactory:

—, no oxidized flavor
?, questionable
+, slightly oxidized
++, distinctly oxidized
+++, very pronouncedly oxidized

If it is desired to ascertain the susceptibility of mixed milk or of milk from individual animals to the development of the oxidized flavor, this may be done by dividing the samples into two or three lots, keeping one lot as a raw control, holder-pasteurizing a second lot, and holder-pasteurizing a third lot after which 0.25 part per million of copper is added. If doubt exists as to the nature of oxidized flavor a representative sample may be prepared easily by adding 0.5 milligram of copper sulfate ($CuSO_4 \cdot 5H_2O$) per liter of winter milk (Trout and Sharp, 1937) and storing the sample at 40° F. or below for 48 hours. The addition of 0.25 part per million of copper may be accomplished easily by introducing into 100 ml. of milk 1 ml. of a prepared copper sulfate solution. This solution may be prepared by adding 0.098 or approximately 0.1 gram of copper sulfate ($CuSO_4 \cdot 5H_2O$) to one liter of distilled water. Fifty one-hundredths, 0.75 and so on p.p.m. of copper may be added by doubling or trebling the milliliters of solution used. In every case the copper solution should be added *after* pasteurization.

SUMMARY

In tracing milk flavor defects to their sources or causes a general knowledge of the characteristics of milk flavors is essential. This involves not only the taste reaction of the milk in question, but also (a) the history of the occurrence of the defect, (b) the conditions usually associated with specific causes and (c) the season of the year when the off-flavor is most frequently encountered. Detailed descriptions of these associations as well as the methods of sampling milk to determine the focal point of metal contamination in the plant are given.

LITERATURE CITED

(1) Gould, I. A. and Jensen, J. M.
1944. Lactic acid in dairy products. II. Relation to flavor, acidity measurements, bacteria count and methylene blue reduction. Jour. Dairy Sci. *27:* 753-767.

(2) Hammer, B. W. and Hix, B. H.
1916. Studies on the number of bacteria in milk showing various changes. Iowa Agr. Exp. Sta. Res. Bul. 29.

(3) Hammer, B. W.
1938. *Dairy Bacteriology.* 2nd Ed. 482 pp. plus xiv. New York: John Wiley and Sons, Inc.

(4) Sharp, P. F.
1941. Factors influencing the flavor of milk. Milk Plant Monthly *30* (*2*): 31-34.

(5) Trout, G. M. and Sharp, P. F.
1937. The reliability of flavor judgments, with special reference to the oxidized flavor of milk. New York (Cornell) Agr. Exp. Sta. Memoir 204. 60 pp. p. 47.

MANAGEMENT IN MICHIGAN HOMES

By IRMA H. GROSS and EVELYN A. ZWEMER
SECTION OF HOME MANAGEMENT

FARM WORK for men and housework for women are at least as old as civilization itself. They are traditional occupations carried on, historically speaking, until very recently in traditional, unquestioned ways.

Business and industry are newer occupations, and they have welcomed the study and improvement of their management. Farm management has now become an accepted part of the scientific study of farm problems.

Home management, however, has been slower in reaching the status of an accepted and vital field of study. Families in general recognize how important their money incomes are. Many families today, especially those living on farms, know that the food they produce is also a very important part of their true income. Some realize that the services of the housewife have economic value. Nevertheless, all families have been slow to recognize that, as in the case of business, industry and farms, the management of the money and other economic resources of the family is a worthy field of study. Just earning money is not enough for family well-being; it is also very necessary to plan what to do with the money once it is earned, what goods and services to buy, what to produce at home and how to use goods after they are obtained. Dorothy Canfield Fisher says, "As vital (for women) for their country's welfare and theirs as to know how to cook vegetables and meat is to know how to keep expenditures of both money and time in proportion with their resources. The wise spending of money is really of life-and-death importance to home life in modern conditions."*

Even less than they realize the importance of management do families consciously know that there is a human as well as a material side to management. They not only have goods and services to manage, but the time and energy of all the family members can be guided to wise usage. There are also personal interests and abilities of the individuals within the family to guide.

*Fisher, Dorothy Canfield—*Our Young Folks*, p. 229.

PROCEDURE

At Michigan State College information about home management has been collected for the past 8 years. First work was done on desirable methods to use to gather information, and the most satisfactory found was the interview method.* Next, in 1939-41, one interviewer, Evelyn Zwemer, visited 382 rural Michigan homes in seven widely scattered counties. Rigid controls were set up and achieved to obtain definite proportions of farm and village families (50 percent each), three economic levels (low, medium, and comfort), families of different sizes with children of different ages, and various occupations. Cases studied included only white, unbroken families, established at least one year, self-supporting and with a homemaker whose chief occupation was home-making.

From the wealth of information gathered about management in Michigan homes, this article will present only a few of the important findings on family planning in general and on management of money, of time and energy, and of the less material side of family living. Those who are interested in a more detailed account will find it in Michigan Agricultural Experiment Station Technical Bulletin 196, "Management in Michigan Homes."

FINDINGS

Planning

Management is primarily the making of decisions and choices. There is a better chance of making wise decisions if they are planned ahead of time and not on the spur of the moment.

Families differed in their habits of planning in general and in the kinds of plans they were accustomed to make. They were least likely to plan the current use of money and of food, most likely to plan savings and for education of their children, thus:

Plan for:	Percent of families having such plans:
Current use of money	24.3
Menus at least one day in advance	28.8
Leisure time for family together	59.4
Housework done by someone not the homemaker	60.0
Use of homemaker's time	72.8
Savings	81.9
Education of children†	83.3

*Gross, Aiken, Tordt, Zwemer and Baten—A Study of Three Methods of Research in Home Management—Michigan State College Agricultural Experiment Station Technical Bulletin 171. February 1940.

†Only families with children included.

The habit of planning rose with economic level in the case of menu making, saving, education of children and arranging for leisure time for the family together. The middle-income families, however, did most planning of current use of money and of the homemaker's time. The village women did more conscious planning than the farm women, especially of current use of money. Increase in economic level and village living were both linked with a higher level of education.

When plans had been made, they varied decidedly as to form and completeness. The accent was definitely on sketchy plans for rather brief periods.

Of the families who planned for current expenditures of money, less than a third used an interval as long as a year. A scant half of the plans were written, and nine-tenths were only partial. Nevertheless the making of plans was habitual for half of the 93 families who made such plans—that is, the families had consistently made spending plans since marriage. One-third of these families had a regular time for making plans and one-half had a regular place for so doing.

Time plans were made at irregular intervals by four-fifths of the women, but three-fourths had used them all of their married lives. Nearly all made them mentally, for only a day at a time, and for only a part of their activities. The plans included the following usages of time:

	Percent of homemakers including:
Work only	6.6
Work and rest	5.7
Work and leisure	24.9
Work, rest and leisure	62.8

With rise in economic level, the proportion of plans including rest and leisure also rose.

Money Management

Families were far more clear on savings practices than on management of current expenditures. Saving was wide-spread, and in more than nine-tenths of these cases was planned. More than half of the savings plans were successfully carried out. Incidence of savings increased with rise in economic level, and reasons for saving varied with economic level. Low-economic level families saved more often for emergencies or to remove debts and less often for education of children.

Financial records show the accomplishments of money plans after they are made. Interestingly enough, about twice as many families kept accounts as made spending plans. Keeping financial records is a much older historical practice than making a budget. It existed among the Babylonians. In regard to savings, as noted above, four-fifths of

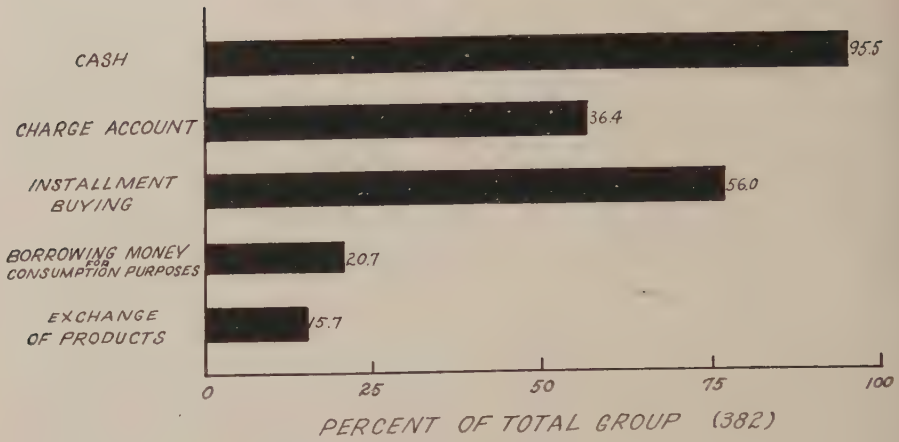


Fig. 1. Methods of payment.

the families planned to save but, according to the housewife's report, only 13.6 percent of the families kept a record of their capital. Household inventories, another type of record of capital, existed in one-fifth of the homes.

Family practices in relation to cash and credit are shown in Fig. 1. These methods of payment are not mutually exclusive, and any one family might have used all five methods. Since the interest of the study was in habitual family practices, the use of installment buying and borrowed money was on the basis of the past three years. The charge account was somewhat more common in families on comfort-economic level than in families on the two lower levels. Installment buying, on the other hand, was more common at the lower levels. Twice as many village as farm families used charge accounts and one-fifth more did installment buying. There was much less purchasing with borrowed money than installment buying, more of the low-income families resorting to borrowing than the medium-level families, and more of the medium than the comfort-level group. The housewives were vague as to conscious reasons for selecting their methods of payment.

The final step in the use of money is the actual purchasing of goods and services. Broad statements are frequently made that the American homemaker does practically all of the buying for her family. Such statements refer to dollar volume of purchases usually, not to kinds of goods bought. The adolescent and older members of both sexes in nine-tenths of the families purchased their own clothing. In two-thirds

of the families, the husband selected the family car and, in similar proportions, the husband and wife together bought household furnishings and selected household improvements.

Management of Time and Energy

Beside investigating the planning of the homemaker's time, the study was concerned with whether the women worked to the point of fatigue and whether other members of the family contributed their time and energy to family tasks.

Interestingly enough, 49 homemakers out of the 382 said they experienced no regular fatigue. They differed from the women who experienced fatigue chiefly in that they were more likely to come from the medium and comfort levels and that they accomplished what they sought to do. The other women were most likely to be tired between noon and 3 o'clock. Taking a rest was not so common as being tired. Slightly more than one-third of the women said they never rested. Of those who rested half stated that they rested less than 30 minutes each day. The time of greatest fatigue was the most popular time for resting.

Time and energy used in the household included more than the contribution of the wife, important as hers was. Other members of the family helped in performing various household tasks. One-fourth of the husbands helped in the general work of the house, the proportion decreasing with rise in economic level. In only 1 out of 11 families did the husband help more than one hour per day. Of those who helped, nearly half assisted with dishwashing; nearly one-third carried heavy loads such as fuel and water. As to assistance in child care and training, four-fifths of the husbands in families with children made a contribution, the proportion rising markedly with economic level.

The work contribution of the children began as early as age 4 or 5. A larger proportion of families received help from children 6-16 than from older children, but the younger ones worked a shorter time. More farm than village children helped and they worked for longer hours. Washing dishes was the chief work contribution of all children.

Paid help was of little importance in these Michigan homes. Less than one-third of the families had any; less than half of this third had it regularly and only 6 of the 382 families had a full-time paid worker.

As soon as the housewife received assistance in carrying on her daily work, new problems of management arose. Checking the work of helpers occurred as follows:

Work checked:	Percent of homemakers checking:
Children	68.8
Paid helpers	57.9
Husbands	6.0

Satisfaction with work done was in somewhat reverse order:

	Percent of homemakers satisfied:
Husbands' work	56.0
Paid helpers' work	23.7
Children's work	20.5

Women on comfort and medium economic levels did nearly twice as much planning with their children as did women on low level. Village women planned more with and for their children than farm women and were more likely to check their work after it was done. The farm women, however, were more careful about planning work for paid help.

Management of Less Material Aspects of Family Living

The well-rounded development of the individual was one of the chief conscious objectives of management stated by these homemakers. It includes, among other factors, awareness of spiritual and aesthetic values in living and satisfactory relationships within the family and with the community. Difficult as it is to put one's finger on intangible matters such as spiritual development, there are some facts which can show objectively the presence or absence of family concern for these essential parts of living. An economist, Elizabeth Hoyt, has aptly said of "------purchasing power, time and energy. Everything, whatever it is, is bought and paid for in terms of these."* These families spent their money, time and energy in many ways that made for the more intangible values of living.

Four indicators were selected as pointing toward spiritual and aesthetic development: church attendance and membership, purchasing of books, buying objects chiefly for their beauty, and enjoyment of nature.

Nearly three-fourths of all the families belonged to some church or attended services, or did both. Fewer low-economic level families had church memberships than those in the upper two levels, and attendance also increased with rise in economic level. There was, in addition, a sex difference in church attendance, more women attending than men. Children from 84.7 percent of the families attended Sunday school.

The books bought by these families included types tending toward spiritual and aesthetic development, thus:

Type of book:	Percent of families buying:
Religious, including the Bible	15.7
Music	9.7
Poetry and art	8.1

**Consumption in Our Society.* New York, 1938. p. 353.

More than half of the women had, during the previous two years, purchased objects for the sole reason that they were beautiful. Any object, however inexpensive, was included in the answers; beauty was the only criterion. Examples were flower vase, flowers, picture, calendar, pitcher. Such purchases increased decidedly with economic level.

As to enjoyment of nature through making flower gardens and taking trips to enjoy scenery, nearly four-fifths of all families employed these practices. Their incidence however rose between the low and the two higher levels, although all families lived in villages or the open country and could have had gardens and enjoyed nature.

Doubtless many families develop happy and satisfying relationships spontaneously and unconsciously but there was evidence, differing with economic level and residence, that some families manage consciously or unconsciously to further the social development of the members.

Toward the promotion of happy family living, recreation for husband and wife together was the method mentioned by five-sixths of the families. Money was spent for family recreation in almost three-fourths of the families; two-thirds of them planned family vacations. Although in the matter of husband and wife planning to enjoy social and recreational activities together, there was not much difference between farm and village couples, there was a decided increase from the low to the two higher levels.

The method of promoting family harmony through spending money for family recreation showed a marked increase from farm to village families and a very appreciable increase between the families of the low and the two higher economic income levels. Whether or not money was spent for recreation, some type of shared leisure was planned by nine-tenths of the families, with variations as for family recreation.

Relationships with the community were studied as to participation in organizations and giving and receiving of hospitality. Membership in at least one community organization, excluding the church, was held by the majority of the persons of the survey over 5 years old. There was a definite correlation with rise in economic level and village living.

Questions on hospitality at meals showed that all but 9 families had invited some guests during the preceding year. Families most commonly invited more than 40 guests per year. A larger number of guests was correlated with rise in income level. Farm families entertained guests at meals but slightly more often than did village families, contrary to the popular idea that farm families have much more company.

Social gatherings were less frequent in the lives of these families than the sharing of family meals, except the giving of parties for older children. The common number of parties per year was between one

and four for both children and adults. The older children and adults invited 13 to 25 guests to their parties. Parties for little children included 12 or fewer guests. Non-attendance at parties given by others was very uncommon for either children or grown-ups.

Democracy of Management Within the Family

The pattern of management was found to be basically democratic throughout as between husband and wife but less so between parents and children. It might have been expected that since the wife gave the answers in practically all cases, she might have aired her grievances if any existed. Presumably there were no general grievances.

In practically all kinds of decisions investigated, more than half of the wives had authority with the husband in making the decision. The exception was that of deciding on method of investment. Only half of the wives in families in which investments were made could give definite answers on this point. Of that half, the majority had a voice in the selection.

Children shared in the making of family decisions chiefly in planning for family recreation and vacations. They shared in general control of family funds in only 1.3 percent of the families. Arrangements for children sharing in family funds varied thus: in one-fifth of the families the children were given regular allowances; in two-fifths they were given money by the parents as they "needed" it and in the remainder of families the children earned money. In some of those families in the last category, the children earned part of their money and received part from their parents. In low-level families and on farms there were fewer regular allowances.

The sharing of work by husband and children is probably a less democratic process than the sharing of money in families. Housework is so predominantly a woman's field that few questions were asked as to who decided what was to be done, when and by whom. Only in the case of supervision was the matter touched. A fourth of the wives planned with their husbands as to his help. A third of the mothers whose children helped had the children assist in the planning of work. Women on medium and comfort levels did somewhat more planning with their children than did women on low levels.

IMPLICATIONS

These farm and village families were more conscious of financial planning for the future than for the present. Over four-fifths planned savings, and only one-fourth planned the day-to-day use of money. If

planning is important in home management as in other types of management, there is much need for making families planning-conscious concerning finances.

Women were more conscious of planning the immediate use of their time than of their money. Their plans generally included work, rest and leisure. How definite these plans were is another matter, as over nine-tenths were reported as only partial and mental plans. The work of assistants was far less likely to be planned than that of the women. The time and energy resources of the entire family, therefore, were fairly comparable with the money resources in vagueness of management although the time and energy of the housewife alone were more consciously managed.

Over half of the families within the preceding 3 years had done some installment buying and a fifth had borrowed money for family use. Installment buying and borrowing are usually reported in terms of proportion retail sales, and of outstanding credit, not in terms of participation by families. The latter figure is more pertinent to home management and points to the need of adequate information on credit for the majority of families.

Within the family, the arrangements on management showed a more democratic pattern between husband and wife than between parents and children. Plans for family fun and vacations were the most democratically made of any family plans. We still have a long way to go before the family is a truly democratic group.

PULLORUM DISEASE, ITS NATURE AND ITS CONTROL

By H. J. STAFSETH and C. W. DARBY
SECTION OF BACTERIOLOGY AND PUBLIC HEALTH

NATURE OF PULLORUM DISEASE

Economic Importance

PULLORUM DISEASE is a widely prevalent, contagious disease particularly destructive to chickens and turkeys. It may also affect other species of birds and certain mammals, such as human beings and rabbits, when they are sufficiently exposed to it. Hatchability of eggs is reduced by 16 or more percent, owing to the destruction of the embryo or fetus. Chick mortality due to this disease may vary in different hatches up to 85 percent, or even more. Egg production is markedly reduced, and occasionally a considerable number of adult birds will die because of pullorum infection, the symptoms exhibited in such cases resembling those of acute or subacute fowl typhoid, fowl cholera or pullet disease (blue comb).

Cause

Salmonella pullorum, a member of the paratyphoid group of bacteria, is the cause of pullorum disease. Unless this germ is present this disease cannot be produced no matter what may happen to a bird. Chilling, overheating, crowding, inadequate feeding or any sort of mismanagement may aggravate an infection, but cannot under any circumstances cause pullorum disease in the absence of *S. pullorum.*

Mode of Spread

S. pullorum may be spread in the following ways:*

1. From the ovary of the hen to the egg to the chick.
2. From infected eggs and chicks through contaminated incubators to other chicks.
3. From chick to chick in shipping boxes, brooders, yards, etc.
4. From chick to chick through contaminated water and feed.
5. From infected adults to chicks and vice versa by direct or indirect contact.

*All this applies equally to chickens and turkeys.

6. By caretakers carrying the germs on their shoes, clothing or contaminated feed bags and utensils.

Infected droppings, infected broken eggs, carcasses of infected chicks or adults, left to be eaten by cannibalistic members of the flock, are important sources of infection. The same is true of down and dust in incubators and brooders, which may have become contaminated. Chicks infected through contaminated down and dust often develop infection of the respiratory tract and may spread infection with discharges from the nostrils and mouth.

Significant Symptoms

High mortality in the shell or during the first few days of life in spite of good general management is a very important indication of the presence of pullorum disease. Other symptoms are: crowding (evidence of fever, chill), diarrhea or pasting of the vent, gasping and constant peeping or "crying."

Significant Tissue Changes

Chicks and Poults: Small, grayish, yellowish or red streaks or spots ("pencil marks") on the liver are quite characteristic of pullorum disease or its very close relative, fowl typhoid. In very acute cases no changes may be found.

Gray spots in the lungs of young chicks and poults are significant. Retained yolks with either "cheesy" or liquid, discolored contents are suggestive. In chronic cases there may be "cheesy" matter in the heart sac (pericarditis). There may be gray spots on the heart.

Adults: Lead-colored or otherwise discolored, misshaped ovules are very suggestive of pullorum disease in mature females. It must be remembered, however, that when laying hens go out of production, for any reason, for a sufficient length of time the retrogressive changes which will take place in the ovary may produce similar changes.

Ocher-colored "cheesy" material in the heart sac of adult males and females is very suggestive of pullorum disease.

CONTROL AND ERADICATION OF PULLORUM DISEASE

Poultry diseases are numerous and differ greatly as to cause and mode of spread. Obviously, then, preventive and curative measures that have been found effective for one disease may be useless when applied against another. Therefore, the first essential in a sound system of control of any disease is the establishment of a reliable diagnosis.

DIAGNOSTIC METHODS

Symptoms and tissue changes may, together with the history of the outbreak, constitute good evidence of the presence of pullorum disease. The same is true of a positive agglutination test properly applied. The most reliable diagnosis is based on the isolation and identification of the cause, *S. pullorum. At Michigan State College a positive diagnosis of pullorum disease in chicks and poults is made only when S. pullorum is isolated.*

Bacteriological Examination

The bacteriological examination is made by streaking special agar plates with tissues, yolk material, blood, intestinal contents or droppings, thereby planting the organism on the nutritive medium. After 24 to 48 hours the organisms will have multiplied sufficiently to form colonies visible to the naked eye. These colonies look like dewdrops of the size of small pin-heads. From these colonies transplants are made from single colonies to agar slants in test tubes. This is for the purpose of getting a sufficient amount of growth to complete the identification which consists of fermentation and other studies. Usually sufficient growth for this purpose is obtained by incubating the agar slant cultures for 24 hours. Transplants are then made to four or five different sugars in a solution containing an indicator which will show whether the organism acts upon the sugar to form acid. The type of tube used also permits the detection of gas formation. Since some organisms produce characteristic reactions in such media, identification is possible in this way. *This procedure requires at least three days* and may take more time if the strain isolated grows poorly or is atypical.

The Agglutination Test

This test is based on the fact that when the blood serum of a bird which has been infected with *S. pullorum* for a sufficient length of time (usually at least one week) is added to a suspension of this organism in physiological salt solution, and this mixture is then incubated for some time

> [For the tube test: (24 hours at 37° C.; *or* 5 hours at 51° C. in a water bath, after which the samples are put into a 37-degree C. incubator overnight. For the plate test: 15 to 120 seconds at about 20° C. or a little warmer)],

the bacteria will clump together (agglutinate) so that one can see the clumps of bacteria with the naked eye. A plate test has also been developed in which freshly drawn whole blood can be used in place of serum. At the present time only the tube agglutination test should be used for testing turkeys. This necessitates the drawing of the blood samples into small tubes and sending the samples to a laboratory to be tested.

Antibodies

The factors which develop in the infected bird in response to the presence of *S. pullorum* in its tissues, are called antibodies. These antibodies are made by certain tissue cells and are discharged into the blood stream. If the living *S. pullorum* is injected directly into the blood stream, antibodies may be detected as early as four days after the injection. When the organisms enter the system through the digestive tract, it will take a week or longer before sufficient amounts of antibodies are formed to be detected by the agglutination test.

Antigen

A substance which stimulates the production of antibodies, when introduced into the tissues of a susceptible animal, is called an antigen. For convenience the same name, antigen, is applied to the known test fluid used in the agglutination test. In the case of the pullorum agglutination test, it is made of killed pullorum germs suspended in physiological saline solution (0.85 or 0.9 percent common salt in water). For plate tests the antigen is more concentrated than when used for the tube test, and it also contains a coloring substance which makes it easier to see the clumped bacteria, especially in the presence of whole blood.

If the bird is able to rid itself of infection, the antibodies will in time gradually disappear. The amount of antigenic stimulation determines the amount of antibodies present. Thus, slight stimulation gives rise to few antibodies which may not be sufficient to give a positive test. A strong antigenic stimulation quite regularly causes the production of a large amount of antibodies. Tests with blood of such antibody content will almost always be strongly positive. However, should there be a marked flare-up of the infection, accompanied by an invasion of the blood, the antibodies may be temporarily neutralized or bound by the bacteria. A bird tested under such circumstances may give a negative or doubtful agglutination test. *Thus, some birds react more or less intermittently, or the strength of the reactions which they give may vary.* Others are remarkably constant reactors.

Specific and Cross Agglutination Reactions

When one speaks of the agglutination test or similar tests he may say that a test is specific, group specific or non-specific. If an organism is of such a chemical composition that it will stimulate the formation of antibodies which will react only with itself, then the reaction produced in the test will be specific for this organism only.

Should, on the other hand, an organism contain an antigenic substance also possessed by other microbes belonging to the same group, then the operator may find that the antigen made from this organism will react with

sera from birds infected with the other members of this group containing the related antigen; or the serum from a bird infected with one organism may agglutinate suspensions of several related organisms. This is what is known as group specificity. Reactions of this kind are also referred to as cross reactions. For example, *S. pullorum* is apparently antigenically identical with the cause of fowl typhoid, *Salmonella* (or *Shigella) gallinarum*. Thus, chickens or turkeys infected with fowl typhoid will give a positive agglutination test when tested with standard *S. pullorum* antigens. Obviously, poultry disease workers are just as anxious to get rid of fowl typhoid as they are to get rid of pullorum disease.

There are also a few other organisms, not belonging to the genus *Salmonella* or *Shigella,* which will cause reactions in the pullorum agglutination test. Such reactions are called non-specific and may also be referred to as cross reactions. Some of these cross reactions are rather weak. However, it is impossible to distinguish them from weak, genuine pullorum reactions.

If a flock shows a considerable number of suspicious reactions to the pullorum test without showing a single really complete agglutination reaction, it is very unlikely that the reactions are due to the presence of S. pullorum.

Interpretation of the Test

In view of those facts, it is evident that one must use judgment, based on experience, in reading and interpreting agglutination tests. Strong or clear-cut reactions (marked clumping = agglutination) are recorded and reported as positive (+), weak reactions (slight agglutination) as suspicious or doubtful (±), and if no reaction at all occurs the test is termed negative (—).

Cloudy Reactions

During the period of egg production hens, especially turkey hens, carry increased quantities of certain substances (proteins and lipoids) in their blood. The serum from such blood looks more or less creamy, and when it is placed in the antigen (tube test only), it gives rise to a "cloudy reaction." This reaction obscures the real agglutination reaction. Therefore, such samples are useless. This is the reason for testing turkeys before the laying season begins.

Hemolyzed Samples

When the red blood cells are dissolved (hemolyzed) the red coloring substance of the blood (hemoglobin) is released into the liquid portion of the blood (called plasma as it occurs naturally, or serum after clotting and

separation have taken place). The red blood cells of birds are rather fragile and a certain number of hemolyzed samples is usually encountered. Old samples usually show hemolysis. Freezing and thawing causes hemolysis. The addition of water to blood also causes hemolysis. *Such samples cannot be tested.* Prolonged exposure to temperatures above 40° F. hastens hemolysis. The blood samples, however, should not be placed in a refrigerator before there is clear evidence of separation of serum from the clot, otherwise there may be little or no yield of serum.

It is important to remember that the test does not depend on the presence of the germs in the blood. Healthy-looking birds are not likely to carry pullorum bacilli in the blood stream. The germs will be found in localized areas in various tissues. In acute cases, when birds are very sick, the germs may be isolated from the blood. This is commonly the case in pullorum-infected chicks and poults. It is important to keep in mind the difference between *testing for antibodies by the agglutination test* and *isolating the organisms by cultural methods.* Antibodies can be produced by injection of sufficient numbers of dead pullorum germs. Several injections are needed when dead germs are used unless the bird has been infected or injected some time previously, in which case it is easier to produce antibodies a second, third or fourth time.

The agglutination test is not generally used for the diagnosis of pullorum disease in young chicks or poults. The authors have found good reactions in a few 4- and 5-week-old chicks. However, the percentage of reactors among infected chicks is not sufficiently high to make this a reliable method of diagnosis. Evidently the tissues must undergo a certain maturation process in order to become efficient manufacturers of antibodies. Mature birds seem to be the best producers of antibodies.

Turkeys differ to a certain extent from chickens in their reactions to the agglutination test. Specifically, the pullorum agglutination test in its present state of development is more efficient when applied to chickens than when applied to turkeys. However, improvements in the technic of applying it to turkeys are being made.

Merits and Limitations of the Test

Some reacting hens may not lay infected eggs or discharge pullorum organisms with their droppings. This is because the foci of infection have been adequately encapsulated; such cases are termed "closed." A bird which discharges the germ is said to have an "open" case. Such a bird is a spreader of infection.

The test is an aid in the detection of normal-looking infected birds (carriers). In this respect it has a considerable amount of merit. However, it is not perfect, because it will not detect all birds that are in the early stages

of infection, and, as already mentioned, a few birds are intermittent reactors. Therefore, one must apply the test repeatedly at monthly or 6-week intervals if eradication is to be accomplished.

A single infected bird in the flock may be the source of a serious outbreak. Therefore, the various percentages of reactor tolerance, which are permitted under the National Poultry Improvement Plan are merely indications of lame steps in the right direction. A "Pullorum Tested" flock, showing more than 2-percent reactors, is a poor risk as a source of stock, and the other grades, with the exception of the "Pullorum Clean" grades, are very little better.

The best source of young stock is the flock that is found to be free of pullorum disease on the first as well as on subsequent tests.

In view of those facts it is obvious that the best hope of eradicating pullorum disease lies in the testing of small, high-grade units of birds, and using the ones that were found clean on the first test as the source of breeding stock.

Flocks found clean on first test are safest source of stock. The reasons for giving preference to flocks found clean on the first test are:

1. Detection and removal of all the infected birds usually requires repeated testing and other sanitary measures such as cleaning, disinfection and even reconstruction of buildings, etc., and

2. Infected birds will contaminate the premises and, hence reinfection may occur in spite of the best efforts to disinfect. Pullorum bacilli may live for some time in shady places. It is impractical to disinfect soil chemically.

What to Do with Reactors

Reactors must be disposed of at the very first opportunity in order to prevent further spread of infection. Suspicious reactors should be handled in like manner if they are not especially good birds. Otherwise they may be isolated and retested.

At present the authors hesitate to say what should be done with pullorum-infected birds. As far as the safety of the rest of the flock is concerned, it is obviously imperative that reactors be promptly removed from the flock and disposed of in such a way as to constitute no further danger as a source of infection. So, reactors might be killed and burned. This is certainly the safest form of disposal. Deep burial with fresh burned lime may also be adequate, especially in places where there is no danger of the carcasses being dug up by birds or animals, or drainage conditions will not permit water to carry infectious material to the surface of the ground.

In the past the customary way of disposing of pullorum reactors has been to slaughter them, and use them for food. Since human beings have

now been found to be susceptible to pullorum disease, one may wonder whether this is a safe procedure. From past experience and on the basis of scientific knowledge we feel justified in saying that this disease cannot be contracted by eating a properly cooked carcass of an infected bird. What danger there may be in handling it, is another question. The opinion of the authors, based on experience, is that this danger is not great.

Guarding Against Infection of Clean Stock

Clean birds must be guarded against infection by being kept on wire, on clean and chemically disinfected cement floors or on clean ground. Obviously, drinking and feeding utensils must be carefully cleaned and disinfected. Chlorine disinfectants used as recommended by the manufacturers are good for this purpose.

Incubators must be cleaned, washed and fumigated when possible. The type of construction of the incubator, to some extent, will determine the type of disinfection to be used.

Brooder houses must also be very carefully cleaned and disinfected if they have been used before.

Caretakers should realize that they can carry infection from one unit to another, especially by tracking the organisms on the soles of their shoes. Therefore, they should take steps to prevent such modes of spread. The use of rubbers, which can be washed and disinfected or changed when going from one place to another, is an effective preventive measure.

Feeding pails and feed bags which are set down, picked up, and carried from place to place may carry infection.

Litter and droppings must be disposed of in such a way as to remove any possible source of infection. The use of screened manure pits, burning or hauling away to places not used for poultry may be effective preventive measures.

Infected eggs are possible sources of infection. Therefore, every effort possible should be taken to prevent poultry from eating raw eggs of any description.

Custom hatching is dangerous unless all the stock from which eggs are obtained is free from pullorum disease. This is true even if different incubators are used, and, especially, if the incubators are in the same room and are operated by the same person.

SUMMARY OF MAIN POINTS

1. Pullorum disease is a very destructive disease of chickens and turkeys *which can be controlled, or even eradicated.*
2. "Pullorum Tested" and "Pullorum Controlled" flocks *are not safe sources* of new stock, because as long as there is *a single infected bird* in the flock, *there is chance of spread* of infection and a *consequent outbreak of pullorum disease.*
3. Pullorum disease spreads insidiously in many ways.
4. Perfectly healthy looking birds may be carriers and spreaders of pullorum infection.
5. Such carriers may be detected by the application of the agglutination test.
6. For testing turkeys the tube test is at present the best. For the testing of chickens the plate test is quite satisfactory.
7. For eradication of pullorum disease, it is best to breed from flocks that are found to be clean on the first test.

   The next best source of stock is flocks that have become pullorum clean after repeated testing and removal of all sources of infection.
8. Contaminated premises may be the source of reinfection.
9. Testing alone, without proper attention to cleaning and disinfection, will not suffice as a means of getting rid of pullorum disease in a flock.
10. *Thorough cleaning must always precede the application of chemical disinfectants.*
11. Use disinfectants that have been properly tested by impartial agencies, and use them as recommended by the manufacturer.
12. Interpretation of reactions to agglutination test:
    (a) Marked, clean-cut agglutination reactions are indicative of infection with *S. pullorum* or its close relative, the fowl typhoid organism *(S. gallinarum)*. Birds giving such reactions should be removed from the flock immediately.
    (b) Weak or indistinct agglutination reactions may be due to pullorum infection. However, such reactions may also be due to the presence of other organisms antigenically related to *S. pullorum*. Valuable chickens giving such reactions should be isolated and retested in 30 to 60 days. If they react on retest they should be eliminated from the flock. Low-grade chickens giving doubtful reactions should be eliminated from the flock without being retested.

(c) "Cloudy" samples cannot be tested because the materials in the blood which cause the cloudiness interfere with the true agglutination reaction and make it impossible to determine the nature of the results. Most of the "cloudy" samples are encountered when testing birds that are in production.

(d) Hemolyzed blood samples are unfit for the agglutination test. Therefore, valuable birds from which "cloudy" or hemolyzed samples are obtained must be retested.

AN INEXPENSIVE HOME-MADE BEESWAX PRESS

By R. H. KELTY and WALTER SHELDON
SECTION OF HORTICULTURE AND AGRICULTURAL ENGINEERING

BEESWAX HAS always been a valuable agricultural by-product. It is more valuable in wartime. Every crumb of beeswax should be saved by every beekeeper.

Commercial equipment for wax rendering is rather expensive and at present may not be available. A simple, inexpensive device for rendering wax may be made at home or by the neighborhood blacksmith for a few dollars, thus encouraging the beekeeper to save small lots of wax which might otherwise be discarded for lack of equipment for rendering. As shown in Fig. 1, the equipment consists of an oil drum with head removed, an angle-iron frame, fastened to the top of the barrel with clamps, supporting a handle operating a simple lever which forces downward a 2-inch by 4-inch plunger to exert great pressure upon a circular plank base placed over the material to be pressed. The device provides ample pressure to squeeze out melted wax, in fact more pressure than a steel barrel can withstand.

Fig. 1. Home-made wax press consisting of an oil drum, angle-iron frame fastened to the rim of the drum by clamps, handle with off-center lever, 2" x 4" plunger and circular plank base.

PROCEDURE

Place the combs or wax refuse in gunny sacks and tie securely. Fill the barrel one-third full of rain water or tap water, softened with ½ cup vinegar or a few drops of sulfuric acid. Boil the water, either

(Article 27-32)

with steam or direct heat, immerse the bags of wax, holding them under the surface of the boiling water with weights or braces. Boil the mass of wax 2 to 4 hours, depending upon the amount in the bags, occasionally allowing the bags to come to the surface and loosening the contents by punching the bags with a piece of 2 x 4 to hasten the heating of the wax refuse. Much of the wax will liquefy, pass through the gunny sack and rise to the surface of the water where it may be skimmed off with a dipper and strained through cheesecloth into a pail or can to cool.

When the refuse has been thoroughly boiled, the wax press is assembled and operated by placing the round plank platform over the bags in the barrel and forcing it downward with successive strokes of the handle meshed in the vertical plunger. After applying pressure, allow the wax to rise for about half an hour and then skim off as before. Or, after cooling, the wax may be lifted off in the form of a cake.

The remainder of the refuse in the bag should be dried. If the dry refuse is crumbly like dry sawdust there is little wax remaining. But if the refuse has a tendency to form a ball when squeezed together, sufficient wax remains to warrant further rendering. Since it is nearly impossible to get the last 15 percent of wax from refuse with home equipment, it is advisable to ship the dry refuse in bags or barrels to one of the companies equipped with machinery to finish the job.

Fig. 2. Wax press assembled, showing how the off-center lever on handle fits holes in plunger to permit successive steps in applying pressure to boiling wax refuse.

VACUUM-TYPE HARVESTER FOR WHITE CLOVER SEED

By S. T. DEXTER and E. G. McKIBBEN
SECTION OF FARM CROPS AND AGRICULTURAL ENGINEERING

THIS IS a progress report on preliminary trials last summer of an experimental harvester assembled by the Agricultural Engineering Section in cooperation with the Farm Crops Section. The vacuum principle is by no means new. The Soil Conservation Service, in cooperation with several state experiment stations, particularly the Chillocothe Substation of the Texas Agricultural Experiment Station and the Fort Hays Branch of the Kansas Agricultural Experiment Station, has worked with this type of equipment for several years as a part of its grass seed harvesting projects. Wileman and Ellis of Purdue reported on the performance of a vacuum type collector for fallen peppermint leaves in the July 1943 issue of *Agricultural Engineering*. There are reports of the use of similar machines by California farmers.

The experimental machine assembled and tested last summer by this station is shown in Fig. 1. A No. 13 Improved Clarage Exhauster with low-speed impeller was mounted on the front of a two-plow all-

Fig. 1. Experimental white clover seed harvester consisting of (1) ground-driven, spring-tooth beater, (2) vacuum fan driven from the belt pulley of a two-plow general purpose tractor, and (3) a two-wheel trailer carrying a canvas container with a burlap air screen top.

(Article 27-33)

purpose tractor. This blower was operated by the standard belt pulley which gave a fan speed of 1,800 r.p.m. with a discharge of about 4,000 cubic feet per minute, with an estimated requirement of about 8 h.p. The discharge was into a large canvas container mounted on a two-wheel trailer. This container had a coarse mesh burlap top to permit the escape of air without loss of seed.

The gathering device which was 3 feet wide is shown in Figs. 2 and 3. Several trials were made with different designs of suction gathering devices but without a rotating beater. In every case, however, the performance was definitely unsatisfactory. The beater shown in Fig. 3 was made of stiff 3/16″ rods and was 12 inches in diameter. The 4.00 x 12 traction-drive tires operating the 2- by 6-inch friction-driven beater tires gave the tips of the beater rods a forward speed with respect to the ground of three times the forward speed of the tractor.

This gathering mechanism is far from perfect. The teeth should be more flexible, the reel should be adjustable with respect to the housing, and the beater should probably be driven from the tractor rather than the ground. Very good results were obtained, however, on the area harvested, and at speed of 3 miles per hour even the narrow 3-foot nozzle would have a capacity of more than three-fourths acre per hour. Because of limitations of time and personnel, this harvester was used on only two acres.

About three-fourths of an acre of ladino clover, a large creeping white clover, was cut for hay on May 26. The second growth had attained a height of 4 or 5 inches by the time the seed was ripe about July 15. A mower, set to cut as closely as possible, was used to clip off the heads and leaves, which were allowed to dry for a few hours in the swath. When picked up with the vacuum harvester, the crop was thoroughly dry.

Another area of about an acre was cut for hay on June 26, and subsequently harvested for seed in a like manner. Because of the extreme drought, the second growth in this case was very sparse, so short, in fact, that the mower bar passed over many of the blossoms.

Part of the material collected from the first area was passed over a clipper mill to determine approximately the proportion of the seed that was threshed out by the harvester. The refuse straw from the clipper mill was subsequently run through a cloverseed huller. It was found that approximately 80 percent of the seed had been threshed by the harvester and was recoverable without further threshing.

Previous experience had shown that, in these short stands, harvesting with a conventional combine was ineffective. Most of the seed was usually left in the field. With the vacuum harvester, from the three-

Fig. 2. Gathering mechanism of experimental vacuum-type harvester for white clover seed.

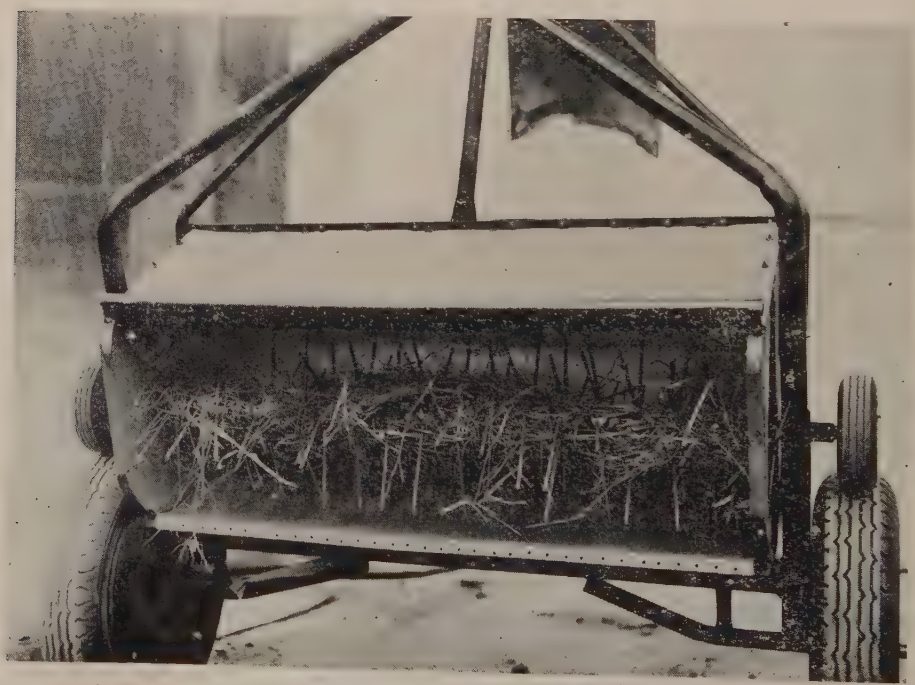


Fig. 3. Bottom view of gathering mechanism of experimental vacuum-type harvester for white clover seed.

fourths of an acre cut on May 26, 120 pounds of cleaned seed (purity above 99 percent) was obtained, a recovery of perhaps 5 to 10 times that of an ordinary combine. From the acre of extremely sparse clover, where harvesting with a combine or a mower would have been out of the question, a yield of 20 pounds of cleaned seed was obtained.

In Michigan there are many acres of white clover seed that are left unharvested each year for lack of a method that will recover this high-priced seed. This preliminary study indicates a very definite possibility for the development of effective harvesting equipment for white clover, ladino clover and other forage and grass seeds by the proper combination of a beating mechanism and a suction nozzle.

REGENT WHEAT FOR THE UPPER PENINSULA

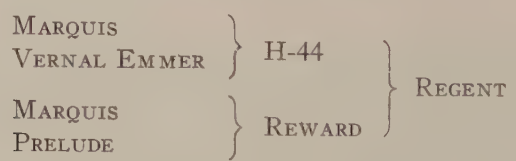
By J. G. WELLS, Jr., D. L. CLANAHAN, and B. R. CHURCHILL
SECTION OF FARM CROPS

CLIMATIC CONDITIONS of the Upper Peninsula are not favorable to the production of winter wheat. Studies of winter hardiness of fall-sown wheats made at the Chatham Station indicate that no variety was sufficiently winter hardy to survive the winters consistently. Production of spring wheat has been limited because of the prevalence of stem and leaf rust and most of the production has been in Chippewa County. No variety has been entirely satisfactory, but Progress and Ceres were grown on a larger acreage than other varieties. To meet all of the requirements a variety should be, (1) highly resistant to both stem and leaf rust, (2) early in maturity, (3) stiff strawed, (4) satisfactory for market, as well as feed, and (5) able to compete with barley in yield.

Regent wheat meets these requirements to a greater degree than any other variety tested and has already demonstrated that it has a definite place on Upper Peninsula farms and may in time largely replace the growing of barley as livestock feed.

PEDIGREE AND CHARACTERISTICS OF REGENT

The pedigree of Regent is indicated below:



The Marquis x Emmer cross was made at the South Dakota Station in 1915. The Marquis x Prelude cross was made at the Central Experimental Farm at Ottawa, Canada in 1911. The H-44 x Reward cross was made in 1926, and the final selection made in 1932. Regent was developed by Cereal Division officials at the Dominion Rust Research Laboratory at Winnipeg, Manitoba, and released for distribution in 1939.

Regent is a beardless red spring wheat of early to mid-season maturity. At Chatham the plants have been medium tall and have resisted

(Article 27-34)

lodging to a greater degree than Wisconsin 38 barley. It is highly resistant to stem and leaf rust and covered smut. No baking tests have been made from wheat grown at Chatham, but other tests indicate Regent to be of high quality for bread making.

REGENT WHEAT AT CHATHAM

Regent wheat came to the Upper Peninsula of Michigan early in 1940 as a trial seed packet in a shipment of vegetable seed from a commercial concern in Winnipeg to the Upper Peninsula Experiment Station at Chatham. It was planted in the co-operative uniform rust nursery by Evart Vander Meulen, research assistant in farm crops. That summer when Dr. M. N. Levine, Pathologist, Bureau of Plant Industry, took notes on the rust nursery he declared that Regent was the first wheat variety—spring or fall—that had ever shown definite leaf rust and stem rust resistance at the Chatham Station. The following year Regent was added to the uniform rust nurseries for all co-operators.

In 1941, Vander Meulen compared Regent with Progress and Thatcher for yield, and rust resistance. Yields were as follows: Regent 32.4, Progress 21.9 and Thatcher 19.8 bushels per acre. Rust coefficients showed Regent to be highly resistant to both stem and leaf rust, Progress to be moderately to highly susceptible to both stem and leaf rust, and Thatcher to be highly resistant to stem rust but highly susceptible to leaf rust.

In 1941 a bushel of certified Regent seed was obtained for the Chatham Station from Manitoba. An acre was grown in 1942, five acres in 1943 and 10 acres in 1944. A comparison of the average yields of barley and wheat show the following:

	Pounds per acre	
	Barley	Wheat
1942	1,836	1,960
1943	745	1,344
1944	1,836	2,286
Average	1,472	1,863

While the foregoing figures are on a field basis and should not be compared directly, they do show a trend. Feeding tables show total digestible nutrients of wheat to be 83.6 while those of barley are 78.7, further revealing an advantage in wheat. Upper Peninsula dairymen have been purchasing wheat in carlots for feed the past two years. They know its value, have found means of grinding it, and have learned how to mix it with protein concentrate to balance the grain with the roughage. No lost time is anticipated in getting wheat fed as soon as it is produced.

In the spring of 1944, the Chatham Station sold limited amounts of Regent seed to about 20 growers. Seventeen returned questionnaires in the fall, stating yields varying from 14.5 to 47.0 bushels per acre. Nine of these men indicated yields of 30 bushels per acre or higher. They reported seeding the crop before May 10, which would be considered an early seeding at least comparable to oats and earlier than barley. With one exception, they reported applications of either manure or commercial fertilizer, or both, or growing the crop on land where potatoes were grown the previous year. Rates of seeding varied from 1½ to 2½ bushels per acre although the majority was seeded at the rate of 2 bushels per acre.

Of the men whose yields fell below 30 bushels per acre, all seemed satisfied with Regent and plan to grow the variety again. Some of the remarks were: "The crop took a beating from hail in the spring and still made 25 bushels." "All of our grain was poor." "I think the yield good considering conditions."

SUGGESTIONS FOR GROWING REGENT WHEAT

On the basis of the three years' results at the Chatham Station, plus reports from 17 Upper Peninsula growers in 1944, the following suggestions are given for growing Regent wheat.

1. Treat the seed with New Improved Ceresan.

2. Prepare a well fitted seedbed where quack grass and other weeds are under control. The ideal location appears to be following potatoes, where improved methods are used.

3. Apply fertilizer at the rate of 250 to 300 pounds per acre of complete analysis such as, 4-16-4. If the crop follows potatoes or corn, manure should be applied before these crops. If a heavy application of commercial fertilizer (500 pounds or more per acre) is made on potatoes, it may be omitted before wheat.

4. Plant the crop as early as possible, even before oats.

5. Seed at the rate of 1¾ to 2 bushels per acre.

SOME NEW IDEAS IN WEED CONTROL

By BUFORD H. GRIGSBY and KEITH C. BARRONS
Sections of Botany and Horticulture

In planning for experimental work most likely to assist the vegetable grower with his wartime problems the writers became interested in certain selective sprays being used elsewhere for the control of weeds in onion and carrot plantings. The upwards of 10,000 acres of these crops grown annually in Michigan require an enormous amount of labor for weeding. Obviously any appreciable saving in the time required for weed control would be a direct contribution to the war effort.

Spraying fields with certain chemicals which kill many weeds but do not harm the crop being grown is not a new idea. In Europe grain crops have long been sprayed with dilute sulfuric acid, and a recently developed chemical called Sinox is now used on thousands of acres of barley and flax in Western United States for selectively killing broad-leaved weeds. Only recently, however, have such methods come into use with vegetable crops. In California large acreages of carrots are being sprayed with stove oil, a petroleum product similar to kerosene which kills many weeds but leaves the carrots unharmed. Experiments have been undertaken in various places on the control of weeds in onions with sprays of Sinox, dilute sulfuric acid, and other chemicals. Sulfuric acid has been used successfully with this crop on a small commercial scale in New York and in England.

Experiments were conducted in 1944 on the use of various chemicals for the selective control of weeds in vegetable crops. Although onions and carrots received the most attention some tests were made with other vegetables including parsnips and canning peas. In addition to the chemicals mentioned above a number of others not yet commercially available were tried. Several petroleum products were used on carrots in an attempt to determine which of those, locally available, might prove satisfactory.

In addition to work with selective sprays, some experiments were conducted on pre-emergence treatment for the killing of weeds by the use of chemical sprays and by burning. Weeds frequently emerge before the crop plants and if the grower delays planting for a few days after fitting the soil an even larger proportion of the weeds will emerge first. The idea in pre-emergence control is to kill these small weeds

(Article 27-35)

just before the crop comes up, thus reducing the amount of hand weeding required. Little has been done elsewhere along these lines, although experiments on the use of sulfuric acid as a pre-emergence spray have been reported in England.

The experiments reported herein on selective sprays and on pre-emergence treatments are definitely of a preliminary nature. No recommendations can be made at this time for the wide-scale commercial use of such methods. However, based on these experiments and recent work at other experiment stations to be discussed later there are certain methods which appear very promising and should be tried on a limited scale by commercial growers in 1945. It is with the thought that every vegetable grower of the state will be interested in keeping abreast of progress along these lines and many will want to make their own preliminary tests of certain methods that this progress report has been prepared.

EFFECTS OF SELECTIVE HERBICIDES ON VARIOUS CROPS

A selective herbicide or weed killer may be effective because it does not wet the crop plant and thus does not actually contact the plant while it does wet and kill many of the common weeds. Such is the action of sulfuric acid in weeding onions. The onion leaves are round and covered with a layer of waxy material whereas the weed leaves are usually broad, flat and have little or none of the waxy covering. Drops of spray are able to adhere to this latter type of leaf and will kill purslane, pigweed, smartweed, and other similar weeds.

Other selective herbicides are effective because certain crop plants are tolerant of the chemicals, while many weeds are killed by them. This type of action is found in the oil-spray treatment of carrots as practiced in California.

In either type of selective action the response obtained may be affected by local climatic factors and by differences in chemicals available in any particular locality. Thus it is desirable to make small test applications before making large scale spray treatments on commercial plantings.

Onions

In order to determine the effect of certain herbicides upon onions a series of replicated plot treatments were made at East Lansing. A muck soil known to be infested with weed seeds was used for all treatments. Each plot was 1/100 acre in size, and four replications of each treatment were made. The various chemicals were applied when the

TABLE 1—*Effect of spray treatment on stand of onions, plants per foot of row*

Location	Treatment								
	Sulfuric acid 2%	Pre-emergence burning	Burning plus acid	Sinox 1% solution	Elgetol 1% solution	G-320* 1:1000	D-289* 1:1000	G-231* 1:1000	Hand-weeded (control)
East Lansing	6.5	5.9	5.8	3.5	5.5	4.7	5.1	5.5	4.8
Eaton Rapids	15.7	9.2	8.5	.....	.....	.....	.....	.....	8.8
Grand Rapids	6.6	8.4	.....	3.8	.....	.....	.....	.....	7.6
St. Johns	8.0	7.0	.....	2.8	.....	.....	.....	.....	6.2

*Materials supplied by the Dow Chemical Company.

onions were 3 weeks old and the first true leaf was evident. The sprays were applied with a knapsack-type sprayer at the rate of 80 gallons per acre. Stand counts were made on five strips of row, each 10 feet in length, and are expressed as the average number of plants per foot of row in Table 1.

Small-scale tests of some of the materials were made in commercial fields at Eaton Rapids, Grand Rapids and St. Johns. Stand counts for these are also shown in Table 1.

Yield data, obtained from the plots at East Lansing, are shown in Table 2. No yield records were taken at the other locations. Actual savings in weeding costs were not obtained because of the small size of the plots involved. It was evident that appreciable savings were made and that on a commercial basis these methods offer possibilities of eliminating a significant part of the hand labor now required.

TABLE 2—*Effect of weed control treatment on yield of onions, bushels per acre*

Grade	Treatment									
	Sulfuric acid	Pre-emergence burning	Burning no cultivation	Sinox water	Sinox in oil	Elgetol	G-320	D-289	G-231	Hand-weeded (control)
U. S. No. 1	388	231	275	184	89	246	284	285	185	218
Small	100	57	68	49	65	62	39	47	69	59
Total bushels	488	288	343	233	154	308	323	335	254	277

Fig. 1. The effect of sulfuric acid, pre-emergence burning and burning followed by acid on weeds in onions: (A) burned and acid-sprayed; (B) pre-emergence burning; (C) untreated; (D) acid-sprayed.

It is evident from these tables that spraying with sulfuric acid does not reduce the number of plants to any considerable extent. The yield of onions from acid-treated plots was much greater than that from untreated ones and also greater than that from the plots treated with other chemicals. Sinox and G-320 were effective as weed-killing agents but also killed a number of the young onions. G-320 seemed to be less toxic than Sinox. The other chemicals were not effective in controlling weeds.

The greater yield in the acid-treated plots may have resulted from action of two factors. The reaction of this particular soil is between pH 6.0 and 6.5, and the acidifying effect of the small quantity of sulfuric acid may have been sufficient to exert considerable stimulation of the onions. Another factor operating in this experiment was the reduction of competition between the crop and weeds by the early removal of the weeds. All weeds not killed by the treatments were later removed by hand weeding, but it was evident throughout the growing season that those plots weeded entirely by acid spraying made more rapid growth and reached maturity earlier than other plots. It appears that competition in early stages of growth plays an important role in the later development of onions.

Growers familiar with these experiments have raised the question of the importance of frequent cultivation in producing good onion yields. Many crop specialists have, in recent years, come to the belief

that the chief function of cultivation is to control weeds and that most soils are sufficiently well aerated so that tillage operations are not needed to secure soil aeration. The experiments reported here support this concept. Plots which were given a pre-emergence burning and no subsequent cultivation produced at the rate of 343 bushels per acre while those having the same treatment and the usual cultivation produced 288 bushels. Control plots, weeded and cultivated in the usual manner, produced 277 bushels per acre. It would seem, then, that frequent cultivation may not be necessary in the production of onions on muckland.

On many Michigan soils a single application of sulfuric acid will not give satisfactory control of weeds. Some weeds appear early and others do not appear until late May or early June. In either case the onion crop may be lost if prompt control measures are not taken and it is not feasible to delay such measures until the late weeds have emerged. The onions will have been injured by shading, and herbicides are not effective on large weeds. Thus, at least two sprayings are necessary for the control of weeds in onions. Sulfuric acid can be applied about 3 weeks after emergence to kill the first crop of weeds and a second spraying can be made early in June to kill purslane without causing injury to the crop. Repeat applications of the other chemicals were not made because of apparent injury from the first treatment.

Sulfuric acid seems to be the most satisfactory material now available for weed control in onions, but its use is limited at present by the lack of suitable spray equipment. It cannot be used in zinc-coated tanks because the action of dilute acid on zinc produces hydrogen gas and a dangerous explosion may occur. The acid is corrosive to iron or steel pump parts and will destroy check valves in a very short time. All-brass or bronze equipment may be used for some time if it is washed carefully as soon as spray operations are finished. The authors have used a lead-dipped knapsack-type sprayer, but these can no longer be obtained. A gear-type pump capable of developing 100-200 pounds pressure should be satisfactory for commercial onion spraying.

The use of sulfuric acid for spraying operations is not so hazardous an undertaking as one might expect. Serious harm can result from improper handling of concentrated acid, but the exercise of certain precautions reduces the danger to the point where there is but little chance of a serious accident taking place. The following precautions should be observed in handling this acid.

1. Always pour concentrated sulfuric acid into water when making dilutions. Dangerous spattering is likely to occur if water is poured into concentrated acid.

2. The use of rubber gloves is advisable when pouring the concentrated acid.

3. Avoid getting the dilute solution on cotton clothing.

4. Do not use zinc or galvanized containers. Wood mixing tanks are preferable to any other sort.

5. Use bicarbonate of soda (baking soda) to neutralize any acid splashed on the hands or face.

6. Wash all equipment thoroughly as soon as spray operations are finished.

7. Do not add spreaders or wetting agents to spray solutions being used as selective sprays. Such materials destroy the selective action of the acid and severe damage to crop plants will result.

Carrots and Parsnips

Small-scale tests were made with various materials on certain other crops. These were not replicated plot tests but were large enough to give information as to the reaction of the crop plant to the chemical and to determine the ability of the chemical to kill weeds.

Carrots and parsnips were sprayed with kerosene, gasoline, fuel oil and other petroleum products. Sinox and G-320 dissolved in kerosene were also used. Fuel oil, Sinox and G-320 are extremely toxic to both young carrots and parsnips and are of no value as selective herbicides for these crops. The kerosene available in Michigan is not toxic to the crop plants but it kills only a few of the weeds. The addition of 5 per cent of naphtha increases the kill of weeds but not to a point where successful control is obtained. Ordinary white gasoline gives complete control of weeds, but the danger from fire prohibits its use for this purpose.

Carrots have been sprayed successfully in California with a petroleum product known as stove oil. This material is not available in this section of the country, and recent work indicates that its effectiveness depends upon the presence of certain impurities in the oil. Refining processes are not all alike and kerosene, distillate and heater oil available here, although they have about the same physical characteristics as stove oil, apparently do not contain impurities in sufficiently toxic quantities.

Oils are absorbed by the carrot crowns and may give the carrots an undesirable flavor. In California it is considered that from 60 to 90 days are necessary for the removal of all the oil from the carrots and a longer period probably is necessary here in Michigan.

Certain commercial solvents have been recommended as substitutes for kerosene by the Massachusetts Experiment Station. Tests of these materials are under way but at the present no recommendations can be made of these materials for use in Michigan except for trial purposes.

Canning Peas

Ragweed, mustards, and nightshade are frequently found in peas grown for canning. All of them produce heavy growth and may reduce the yields of peas. The immature fruits of nightshade are sometimes found in shelled peas and produce an undesirable flavor in the canned product and are poisonous. Preliminary tests have shown that these weeds may be controlled by selective spraying. Sinox has been used in the West, and tests performed by the authors show that it may be useful under some conditions. However, concentrations must be controlled carefully to avoid injury to the foliage of the peas and the addition of ammonium sulfate as an activator should be avoided. G-320 (ammonium salt of di-nitro-ortho-secondary-butyl phenol) seems to give satisfactory control of weeds and less injury to the foliage than Sinox. These are limited observations and further tests of these materials on peas are needed. Both compounds are water-soluble and non-corrosive. A 1-percent solution of Sinox applied at the rate of 100 gallons per acre or G-320 at a dilution of 1:1000 at the same rate applied when the peas are not more than 6 inches tall should give fair control of weeds and not cause excessive injury to the peas.

PRE-EMERGENCE TREATMENT

Under some conditions weed control measures may be applied after seeding but before the crop plants have emerged. Such treatment may consist of burning young weed growth or the application of herbicide to kill the weeds.

The effect of pre-emergence burning on onions is shown in tables 1 and 2. Flame from an oil-burning torch was used in these trials, either a single burner or a unit consisting of three burners mounted under a metal hood covering a 30-inch strip of soil. In either case the flame was moved over the soil at a slow walking speed. All weeds except grasses were killed and no injury to the onions was found. All burned plots later were infested with purslane and other control measures were necessary. A single spraying with sulfuric acid killed most of the purslane and made hand weeding unnecessary. Pre-emergence burning also gave satisfactory results with asparagus crowns grown from seed.

A combination of pre-emergence burning followed by sulfuric acid spray appears to be a convenient method of controlling weeds in crops whose seeds germinate slowly. The results have been satisfactory with onions and there may be other crops to which the method could be adapted.

Some materials applied as selective sprays may also be used as pre-emergence treatments. Dry Sinox dissolved in oil and applied prior to emergence eliminated the necessity for hand weeding carrots planted in July. Weed seedlings did not appear and no injury to the carrots was observed.

DISCUSSION

The results of these limited experiments indicate that it may be possible to control weeds in crops that have a high requirement for hand labor by chemical sprays. Several chemicals are available for this purpose and new ones are being developed. Recent work at the New York Experiment Station with growth substances has opened a new line of work, and the search for new herbicides continues. Careful testing of many materials must be done before specific recommendations can be made for Michigan crops and equipment for applying them must be developed. It is expected that work along these lines will be continued at this station and that some improved methods for controlling weeds in onions and carrots can be devised.

These experiments do not warrant making specific recommendations of selective sprays for commercial usage. In view of the shortage of labor, however, it is possible that some growers may wish to make trial applications of some of the chemicals that are being used in other areas. The authors feel that certain weed control measures are worthy of trial by growers who have or can secure suitable equipment. Those more likely to be satisfactory are:

1. Pre-emergence treatments:

These are most likely to prove of value with crops that are slow to emerge, such as parsnips and asparagus being grown from seed. With other crops a greater proportion of weeds will emerge first if seeding is delayed a few days after the seedbed is prepared. The following methods offer possibilities.

(A) BURNING. Suitable equipment has yet to be designed and built, but the idea has been tested on a small scale and found to be good. Little or no danger of starting a muck fire exists in the early spring. At that season the soil is usually quite wet and ignition of the muck is not likely to occur.

(b) Spraying. 2-percent sulfuric acid with a spreader added has been used. Lacking equipment for applying acid, growers with ordinary spray rigs would find 1-percent Sinox, with ammonium sulfate added according to the manufacturer's directions, more suitable. If available in the coming season, G-320 at a dilution of 1:1000 might prove satisfactory. All sprays should be applied at the rate of 100 to 150 gallons per acre, depending on the amount of weeds present.

2. *Selective sprays:*

Selective sprays will not give satisfactory results in cool, wet weather. Bright warm days immediately after a rain are to be preferred for spraying operations. Sulfuric acid, however, will be effective under conditions not favorable for the other chemicals.

(a) Sulfuric acid on onions. A 2-percent solution, without spreader, applied about 3 weeks after emergence and again 2 weeks later should control most weeds in onions. 100 gallons per acre are sufficient if sprayed over the rows only but if the entire surface is covered 150 gallons will give better results.

(b) Sinox on onions. 1-percent Sinox at the rate of 100 gallons per acre may be used but some reduction in stand may be expected. Ammonium sulfate should not be added and the onions should be 3 weeks old at the time of spraying. A certain amount of risk is involved, and a small test spraying should be made before treating a large acreage.

(c) G-320 on onions. If this material is available it may be used. Three-fourths pound of the dry compound in 100 gallons of water applied to one acre will not injure onions. Good weed control may be expected if the weeds are small. Large weeds will not be killed.

(d) Oil substitutes on carrots and parsnips. Our experiments with kerosene and other petroleum products did not give satisfactory control of weeds; however, Sovasol No. 5 or a mixture of Sovasol No. 75 with white kerosene (1 part to 2 parts of kerosene) has been recommended for use on these crops by the Massachusetts Agricultural Experiment Station. Small-scale trials of these materials could be made on carrots. Should the results be satisfactory the method could then be extended to larger plantings. These materials are reported to leave no oily flavor in the carrots.

PRELIMINARY RESULTS OF ARTIFICIAL INSEMINATION THROUGH A COOPERATIVE ENTERPRISE

By W. W. SNYDER and A. C. BALTZER
SECTION OF DAIRY

IN DECEMBER 1943, more than 100 dairymen met in East Lansing and unanimously passed a recommendation to organize and develop a federated type of artificial insemination program for Michigan. Between this date and March 30, 1944, 11 local units were organized throughout the state. On March 30, 1944 the directors of these units and other interested dairymen met and organized the Michigan Artificial Breeders Cooperative, Inc. Directors from these 11 local units met and elected officers for the central organization at this time. Two months were required to purchase bulls, work out details for housing these bulls, train the inseminator-managers, obtain all necessary equipment and supplies, and start shipping semen. By May 31, 1944, 13 local units were organized and each unit had a trained inseminator-manager. The first samples of semen were shipped on this date. It is the purpose of this paper to present some of the preliminary results obtained by the organization during the first 6 months of operation.

The first samples of semen were shipped to four local units May 31, 1944. By June 9, 13 local associations were receiving regular shipments three times each week. During September, October and November, 18 local associations were included on the mailing list. The number

TABLE 1—*Progress of the Michigan Artificial Breeders Cooperative, Inc. during first 6 months (June-November 1944)*

	June	July	Aug.	Sept.	Oct.	Nov.
Local artificial breeding associations	13	14	18	18	18	18
Herds subscribed	520	570	817	872	946	1,044
Cows subscribed	4,400	5,400	6,900	7,400	8,200	8,900
Bulls in central stud	10	14	14	16	16	18
Ejaculates of semen collected	113	99	102	82	107	88
Ejaculates of semen used	57	60	63	62	62	58
Volume of diluted semen sent* (ml.)	1,200	2,200	2,900	3,100	3,100	3,200
Tubes of semen sent*	359	446	516	625	625	628
Packages sent*	161	170	214	234	235	235

*All semen was sent by special delivery mail except that which was sent by bus to one local association.

(Article 27-36)

of herds subscribed and the number of cows subscribed doubled during the first 6 months. This is indicative of the farmers' interest in the program. It should be noted that these increases during the last 3 months were without the addition of any new local associations. The 10-percent increase in membership during November indicates that these new members were satisfied with the results obtained by their neighbors.

To insure sufficient high quality semen the number of bulls had to be increased from 10 to 18 in 6 months. These 18 bulls included eight Holsteins, six Guernseys, and four Jerseys. Generally, the bulls were used once each week and two ejaculates collected each time. Since semen was collected on Monday, Wednesday and Friday of each week it was possible to select bulls providing the best semen. All semen was critically examined under the microscope and rated according to progressive motility. The motility ratings were usually 85, 80, 75 or lower. A rating of 85 meant that 85 percent of the spermatozoa were morphologically normal and moving in a rapid, progressive manner. Semen with a rating below 70 was not considered satisfactory. Whenever possible, semen with a rating of 80 or 85 was used and the lower rating semen discarded. The average number of ejaculates collected per month from all bulls was 98.5. Fifty-nine percent of these were sent to local associations.

The demands for semen have greatly increased as may be noted by the volume of diluted semen sent. In June 1200 ml. were sent, while in November the volume increased to 3200 ml. This increased volume was obtained in part by increasing the rate of dilution. No semen was diluted more than 1:20 with an average rate of about 1:15 during the last 3 months. This rate of dilution means that one volume of semen was diluted with about 15 volumes of fresh sodium-citrate egg-yolk buffer diluent. The increase in number of tubes of semen and packages sent is further evidence of the growth of the organization.

A summary of the field results obtained by the 18 local associations during the first 5 months is presented in Table 2. These data include all results obtained through October 31. It is impossible to include

TABLE 2—*All cows inseminated and the non-returns after two services (June-October 1944)*

	June	July	Aug.	Sept.	Oct.	Total for 5 mo.
Inseminations (first and second)	691	829	802	755	744	3,821
Non-returns (first and second)	359	508	514	500	523	2,404
Percent non-returns (average)	52	61	64	66	70	63
Total number of cows bred						2,685

more recent data since at least one month was allowed for a recurrence of a heat period. Thus the results for October were recorded and summarized during December.

A non-return was a cow that had been inseminated a first or second time and did not have a recorded recurrence of a heat period during the following month and, thus, was assumed to be in calf. For example, if a cow were inseminated the first time September 15 and no further inseminations were requested during October this cow was assumed to be a non-return. This cow should have had a recurrence of heat October 6 and again October 27 unless she conceived by the first insemination. Since all these cows were not examined for pregnancy the term "non-returns" is preferred to "conceptions," or "rate of conception." Only the first and second inseminations were used to calculate non-returns since the association allows three inseminations for the original service fee. Including third inseminations would tend to introduce inaccuracies because the farmers may or may not request the fourth service. There is no accurate way of determining recurrence of the fourth heat period aside from special farm visits.

These data in Table 2 show a definite increase in the percentage of non-returns for each month. Most certainly the increase from 52 percent in June to 70 percent in October is a noteworthy increase. The average non-returns for the 5 months is 63 percent. During the 5 months there were 2,404 cows as non-returns and these were assumed to have conceived. This was accomplished by inseminating 2,685 cows. The total number of first and second inseminations was 3,821 which indicates that there were 1,136 second inseminations (3,821 less the 2,685 first services). The number of cows assumed to be in calf after the first service may be estimated by the difference between the total number of first services (2,685) and the total number of second services (1,136) which would be 1,268 or 47 percent of all cows inseminated. Likewise the non-returns after the second service were 1,136 or 42 percent of the total. This would indicate that about 89 percent of all the cows conceived after the second insemination. Some services have been requested for a few cows after two or more heat periods have elapsed. These cases will naturally lower the total percentage of non-returns in the final analysis. It is probable that not more than 15 percent should require a third service.

These preliminary data indicate that satisfactory impregnations have been obtained.

COMPARISON OF HOMINY FEED AND GROUND YELLOW CORN IN A BROILER RATION

By J. A. DAVIDSON, C. M. McCRARY, and C. G. CARY
Section of Poultry Husbandry

"Hominy feed" is a mixture of the bran coating, the germ (with or without a partial extraction of the oil), and a part of the starchy portion of the corn kernel. It is obtained in the manufacture of hominy, hominy grits and table cornmeal. It may or may not contain the germ or the corn oil, the analyses thus varying in fat from about 3 to 8 percent. It is somewhat more bulky than ground corn, slightly lower in nitrogen-free extract, higher in fiber, and higher or lower in protein than corn, depending on whether the corn germ is present or absent.

The carotene (sometimes called "pro-vitamin A") content depends upon whether white or yellow corn has been processed and upon the amount of fat present.

In 1943 between 275,000 and 300,000 tons were available for animal feeding purposes. This by-product of corn-processing for human food was used to the fullest extent during the recent shortage of carbohydrate feeds for animals. Considerable work has been done on the value of hominy feed in the rations of other animals.

Since no report on the comparative feeding value of hominy feed and corn for chickens had come to our attention, and because a considerable amount of hominy feed is produced in Michigan and normally sold at a slightly lower price than ground yellow corn, it was thought desirable to run some feeding trials with chickens.

Since a two-story, 20- by 80-foot permanent brooder house had recently been constructed on the Michigan State College W. K. Kellogg Demonstration Farm at Augusta, Michigan, it was assumed that the facilities were suitable for an experiment substituting hominy feed for corn in a broiler ration. Such tests should be more critical than substituting in a laying ration where whole grains constitute about half of the total feed intake.

The brooder house is constructed with four 20- by 20-foot pens and a service room on the first floor; the second floor has four 20- by 20-foot pens and one in the center that is slightly smaller because of the space required for the stairway.

(Article 27-37)

In October 1942, several lots of chicks were started in this new brooder house. Mash mixtures containing varying amounts of hominy feed and corn were fed to the different lots. A severe outbreak of coccidiosis was encountered in many of the pens. Since this parasitic disease was encountered in all of the pens in varying degrees, it was impossible to draw any satisfactory conclusions regarding the various combinations of corn and hominy feed.

The hominy feed used in this test, as well as in all subsequent tests, was white hominy feed with approximately 6-percent fat. This material was supplied by the W. K. Kellogg Company of Battle Creek.

SUMMER BROILERS : JUNE TO SEPTEMBER 1943

Three varieties of June-hatched chicks, consisting of Barred Rocks, White Rocks, and a Dark Cornish-White Leghorn cross, were started. Each variety was divided into two lots: one lot being fed a broiler mash containing corn and the other a mash containing hominy feed. The mixtures were made up as shown in Table 1.

The chicks were started on peat moss litter. The litter was allowed to remain until the end of the fourth week. Peat moss again was used until the sixth week when coccidiosis appeared in one pen of White Rocks. After the sixth week all pens were cleaned weekly until the broilers were sold, with straw being used for litter.

Electric brooders were used as a source of heat and were disconnected during the day when outside temperatures were sufficiently high. They were removed at the end of the seventh week.

Chicks were weighed individually and their sex noted at 9 and 14 weeks of age. It was impossible to determine accurately the sex of some White Rocks and Cornish-Leghorn cross when 9 weeks old.

The birds were confined to the house during the entire period.

TABLE 1—*Broiler mash mixtures*

Ingredients	Mash No. 1	Mash No. 2
Ground yellow corn	600	—
Hominy feed	—	600
Wheat bran	250	250
Flour middlings	250	250
Fine ground oats	250	250
Alfalfa meal (dehydrated 17%)	100	100
Meat scraps	100	100
Soybean oil meal	240	240
Fish meal	50	50
Dried whey	60	60
Steamed bone meal	30	30
Ground limestone	40	40
Iodized salt	20	20
Animal feeding oil (400 D—1000A)	10	10
Manganese sulfate	4 ounces per ton	4 ounces per ton

Table 2—*Comparison of hominy feed and corn*

Summer Broilers, 14 weeks old: June to September 1943

	Corn			Hominy feed		
	Cornish-Leghorn	Barred Rocks	White Rocks	Cornish-Leghorn	Barred Rocks	White Rocks
Number chicks	162	255	249	206	259	258
Number died	15	14	76	18	40	34
Percent mortality	9.3	5.4	30.5	8.7	15.4	13.1
Number cockerels	68	125	90	94	108	96
Average weight, pounds	2.98	2.98	3.03	3.02	2.91	3.25
Number pullets	79	116	83	94	111	128
Average weight, pounds	2.48	2.60	2.58	2.48	2.53	2.69
Mean weight, pounds	2.73	2.79	2.80	2.75	2.72	2.97
Mash consumed, pounds	1,791.00	2,732.75	2,275.75	1,957.5	2,495.75	2,477.75
Grain consumed, pounds	324.75	518.00	431.00	399.25	512.00	497.5
Total feed consumed, pounds	2,115.75	3,250.75	2,706.75	2,356.75	3,007.75	2,975.25
Feed per pound of broiler	5.29	4.81	5.54	4.57	5.04	4.52

The number of chicks, number dying, percent mortality, the number of each sex, the average weight, the amount of feed consumed and the feed required to produce a pound of broiler are given in Table 2. These figures show very little differences in average weights within the same sex and breed. In the Cornish-Leghorn cross the weights are practically identical. The differences in the Barred Rocks and White Rocks are contradictory in that the Barred Rocks receiving corn were heavier and the White Rocks receiving hominy feed were heavier. This was probably due to the fact that losses were heavier from coccidiosis in the Barred Rocks receiving corn and in the White Rocks receiving hominy feed.

Differences in the amount of feed necessary to produce a pound of broiler were noted. Part of this undoubtedly was due to the unequal presence of the organism causing coccidiosis. However, in the Cornish-Leghorn group there was little difference in mortality. The amount of feed required may vary widely with the coarseness or fineness of a feed, the type or style of feeders used and the amount of feed or level to which the feeder is filled. This led to a trial in a battery chick brooder where better control in respect to identical conditions can be had.

CHICK BATTERY TRIAL

Two groups of 36 Barred Rock chicks were used, one being given hominy feed instead of corn in the same mash mixture which had been used at the W. K. Kellogg Farm. These chicks were brooded in batteries at Michigan State College. The feed and chicks were weighed at the end

TABLE 3—*Comparison of corn and hominy feed—30-percent level battery brooder test*

January-March 1944

	Hominy feed		Corn	
Number chicks	36		36	
Number died	5		2	
Weights, mean grams	15 Males	16 Females	15 Males	19 Females
1	52.6	54.0	53.6	56.0
2	84.0	83.4	82.6	92.6
3	129.0	143.1	135.0	155.0
4	186.6	205.9	211.0	230.5
5	270.3	284.0	295.0	311.8
6	362.0	367.5	382.6	400.0
7	480.0	464.5	486.3	490.5
8	601.6	510.0	605.0	592.6
9	750.3	703.4	753.6	730.7
10	903.0	833.7	908.3	870.7

of each week. Table 3 shows the mean weight of the males and females for each week. Table 4 gives the amount of feed consumed and the gain-feed ratio.

In this trial the difference in the amount of feed required to produce a pound of broiler at 10 weeks was very small. The difference in the mean weights at 10 weeks was 5 grams for the males and 37 grams for the females in favor of the corn. Thus in a feed mixture of this nature there was very little difference.

TABLE 4—*Feed consumption—hominy feed and corn*

January-March 1944

Week	Hominy feed		Corn	
	Amount of feed (pounds)	Gain / feed ratio	Amount of feed (pounds)	Gain / feed ratio
1 to 2	7.0	.296	8.5	.293
2 to 3	8.0	.449	9.5	.468
3 to 4	13.5	.305	17.5	.318
4 to 5	16.0	.345	19.5	.317
5 to 6	20.5	.291	23.5	.280
6 to 7	24.0	.304	26.0	.277
7 to 8	29.0	.270	33.0	.248
8 to 9	35.5	.268	36.5	.293
9 to 10	36.5	.264	41.0	.267
Total	190.0	.284	215.0	.290
Feed per pound of broiler	.....	3.205	.....	3.211

Table 5—*Comparison of corn and hominy*

Winter Broilers, 14 weeks old: Oct. 1943-Jan. 1944

	Corn	Hominy
Number chicks	510	1,020
Number died	51	105
Percent mortality	10	10.2
Number culls	13	24
Number cockerels	162	355
Average weight, pounds	3.87	4.04
Number pullets	284	536
Average weight, pounds	3.32	3.04
Mean weight, pounds	3.59	3.54
Mash consumed, pounds	6,858	11,666
Grain consumed, pounds	1,104.5	2,246
Total feed consumed, pounds	7,962.5	13,912
Feed per pound of broiler	4.98	4.46

WINTER BROILERS: OCTOBER 1943 TO JANUARY 1944

In October 1943, 510 White Rock chicks were started at the Michigan State College W. K. Kellogg Farm on the same mixture as that used in the summer of 1943 containing 30-percent corn, and 1,020 chicks were fed a similar mixture with hominy feed replacing the corn.

The results are given in Table 5. The death loss was 10 percent and 10.2 percent, respectively, for the corn and hominy feed groups. The number unsuitable for sale at the close of the test was practically the same. The males in the hominy fed group averaged slightly heavier, but the pullets were lighter than those receiving corn. There was a slight difference in the total weight in favor of those receiving corn. However, on the amount of feed required to produce a pound of broiler there was approximately a half pound difference in favor of the hominy feed mixture. Some of this might be accounted for in a slight difference in the amount of scratch grain fed.

COMPARISON OF 30- AND 40-PERCENT LEVELS OF HOMINY FEED, JUNE TO SEPTEMBER, 1944

Since the use of 30-percent hominy feed in the broiler ration seemed satisfactory, in place of corn, it was thought desirable to increase the hominy feed to 40 percent by replacing some of the wheat by-products.

Table 6 shows the mortality, mean weights, and feed consumption data. There was practically no difference in the mean weight in either the Barred or White Rock broilers. However, there was a difference in the amount of feed required to produce a pound of broiler. This difference was more likely due to the position of the pens rather than

TABLE 6—*Comparison of 30- and 40-percent levels of hominy feed*

Summer Broilers, 93 days old: June 9-Sept. 10, 1944

	30 percent hominy feed		40 percent hominy feed	
	Barred Rocks	White Rocks	Barred Rocks	White Rocks
Number chicks	259	779	259	260
Number died	84	152	70	30
Percent mortality	32.4	19.5	27.0	11.5
Number culls	8	17	2	4
Number cockerels	84	318	85	134
Average weight, pounds	3.41	3.31	3.37	3.43
Number pullets	83	292	102	87
Average weight, pounds	2.97	3.10	2.93	2.90
Mean weight, pounds	3.19	3.20	3.15	3.17
Mash consumed, pounds	3,362	11,382	3,402	3,493
Grain consumed, pounds	306	1,040.8	311	351.2
Total feed consumed, pounds	3,668	12,422.8	3,713	3,844.2
Feed per pound of broiler	6.66	6.23	6.29	5.33

any effect exerted by the amount of hominy feed in the ration. Some coccidiosis occurred, especially in one lot which was fed on the mash containing 30-percent hominy feed. Thus, more feed would be required since there is a distinct loss in weight during an attack by the parasite.

DISCUSSION

Hominy feed in a combination of feed-stuffs such as were used in these trials can be used in place of ground yellow corn. Vitamin A was amply supplied by fish oil and 5-percent of a dehydrated alfalfa meal (17-percent protein). In respect to the other nutrients supplied (even though there are some differences), there was no difference in feed utilization, as shown in Table 4. From the results given in Table 6, part of the wheat by-products may also be replaced by hominy feed without decreasing either the feed utilization or mean weights of the broilers. How much can be replaced is not known since only two-fifths was replaced in one trial.

There were some differences in pigmentation of the skin and shanks. The pigmentation was less where hominy feed was used. The difference, however, was not sufficient to cause any trouble from the standpoint of acceptance by the poultry buyer.

There seems to be some saving in feed required to produce a pound of broiler under the floor system of rearing. This is apparently due to the mechanical differences between the corn and hominy feed. Feed wastage with the type of floor feeders used is evidently less when hominy feed is used in the feed combination. Table 4 bears out this statement. Thus if suitable alfalfa meal and animal feed oil are avail-

able it may be desirable to use hominy feed in place of corn in the broiler ration, especially if the price of hominy feed is equal to or less than the price of ground yellow corn.

The mortality was not affected by the replacement of corn by hominy in this combination of feed-stuffs. The percentage of culls or unsaleable broilers was practically the same on each mixture.

SUMMARY

Hominy feed such as used in these feeding tests may replace the yellow corn in a broiler ration when suitable and ample Vitamin A supplements are used.

A saving in feed may be accomplished in a feed mixture of this nature when broilers are reared under floor brooders. The reason for this is not clear, but it is apparently due to the difference in feed wastage.

SPRING WHEAT AT EAST LANSING, MICHIGAN

By HUBERT M. BROWN
FARM CROPS SECTION

IN THE Lower Peninsula of Michigan spring wheat growing has been attempted by various individuals from time to time, but few of them have continued with it over a period of years, chiefly because of the low yields of grain obtained. A supposition has become established that spring wheat will "run out" in a year or so and so would have to be renewed. This has meant that spring wheat seed has to be obtained from the spring wheat area west of Lake Michigan, with the result that such seed is comparatively high priced. Tests with spring wheat were begun in 1937 at East Lansing. The data for the intervening 8-year period, 1937-44, are given in Table 1.

Spring wheat is like barley and oats; it must be planted early. The average date of planting for the past 8 years is seen from the table to be April 23.

The suggested rate of planting is 1½ to 2 bushels per acre. Seed should be thoroughly cleaned and then treated with New Improved Ceresan or similar product to control bunt.

Fertilizers recommended for winter wheat may be used, such as 250 to 300 pounds per acre of 0-14-7, 0-20-20, or 18 to 20 percent super-

TABLE 1—*Spring wheat planting trials at East Lansing, Michigan, 1937-44*

Year.....	1937	1938	1939	1940	1941	1942	1943	1944	Average
Date* planted....	May 7	Apr. 16	Apr. 27	Apr. 23	Apr. 25	Apr. 17	Apr. 21	Apr. 21	Apr. 23
Date* cut.....	July 31	July 24	Aug. 3	July 30	July 22	July 26	July 26	July 24	July 27
No. of days after winter wheat**....	14	12	27	8	14	19	10	17	15
Bushels per acre—winter wheat	27.1	35.8	32.7	28.5	36.0	32.6	33.2	35.2	32.6
Bushels per acre—spring wheat	3.0	16.3	12.5	27.2	9.8	16.5	21.4	22.4	16.1
Bushels per acre—difference***	24.1	19.5	20.2	1.3	26.2	16.1	11.8	12.8	16.5

*Dates of planting and cutting (binder harvest) are for spring wheat.
**Number of days that spring wheat harvest is later than winter wheat harvest.
***The comparative bushels per acre yields of grain are averages of all the varieties in each wheat test.

(Article 27-38)

phosphate. See "Fertilizer Recommendations," Extension Bulletin 159, for further suggestions.

In point of harvesting, spring wheat has been considerably later than the winter type (15 days over the 8-year period) and has also been later than barley or oats.

Yield of grain is the result of many factors. Among these are resistance to spring infestation of hessian fly, to stem and leaf rust, to scab, and to adverse weather conditions. None of these factors is controlable through seed treatment or similar practices. Named varieties which, for various reasons, have proved unsatisfactory in these East Lansing tests include Baart, Hope, Marquis, Mercury, New Hope, Premier, Regent, Thatcher, and White Federation.

Several strains and other named varieties are still on test. Unfortunately, the lines giving the most satisfactory results, at present, are bearded. Desirable beardless types are being sought.

The data at hand indicate that failure to plant early enough, injury due to hessian fly, damage done by stem rust, leaf rust or scab, and failure to maintain purity and to plant clean plump seed are among the chief factors for so-called running out.

EFFECT OF SNOW-ICE ON THE RETENTION OF VITAMIN C IN GREEN VEGETABLES DISPLAYED IN A RETAIL MARKET[1]

By LOIS GORDON, RUTH M. GRISWOLD, and THELMA PORTER
SECTION OF HOME ECONOMICS

THE DESIRABILITY of a high degree of preservation of the vitamin content of fresh, green vegetables during the period of wholesale and retail distribution is acknowledged by both distributors and consumers. At the present time, with the increased interest of the homemaker in foods of high nutritive quality, methods of improved harvesting and storage are being carefully studied and developed by all of the agencies concerned.

This report[2] deals with a study of the effect of displaying green vegetables with and without the use of snow-ice in a retail grocery.[3] Vitamin C (ascorbic acid) was chosen for study because green vegetables, in the freshly picked condition, contain significant amounts of this vitamin, and also because vitamin C is sensitive to changes in temperature and humidity, and to exposure to the oxygen of the air. Therefore, it makes a delicate index of the effects of handling vegetables in different ways.

REVIEW OF SELECTED STUDIES

Tressler, Mack, and King (1936) found that spinach stored at approximately 34° to 37° F. lost its ascorbic acid (vitamin C) very slowly, while that held at room temperature lost about half of its ascorbic acid in 3 days and practically all of it in 7 days. Wheeler, Tressler, and King (1939) reported that refrigeration reduced the loss of ascorbic acid in some vegetables to a negligible figure, but was not so effective with lettuce and kale. In a recent study made in Wisconsin, Zepplin and Elvehjem (1943) investigated the preservation of vitamin C in spinach, broccoli, lettuce, Swiss chard, and green beans during various conditions of storage. Ascorbic acid was destroyed rapidly when the vegetables were stored at room temperature (68°-73° F.); reducing the temperature to approximately 43°-54° F. favored the preservation of vitamin C.

[1]The expenses of this investigation were defrayed by a grant from Charles F. Belshaw, Belshaw Snow-Iced Vitamin Sealed Produce System, Greenville, Michigan

[2]Paper read before the twenty-seventh annual meeting at the Michigan Ice Industries Association, March 24, 1944, Lansing, Michigan.

[3]The authors wish to acknowledge gratefully the cooperation of Earl C. Beeman, 1138 S. Washington Ave., Lansing, Michigan, proprietor of the grocery in which this study was conducted.

(Article 27-39)

Further work proved that retail refrigeration of either the mechanical, ice, or ice-display case type was effective in retarding the destruction of vitamin C.

EXPERIMENTAL WORK

Two types of display units were employed in this study: the conventional non-refrigerated sheet-iron rack and the Belshaw Vitamin Sealed Snow-Ice Produce System. Three vegetables were studied: leaf lettuce, green beans, and spinach. These fresh vegetables were obtained by the cooperating grocer from Michigan wholesale dealers and were stored in a refrigerator at approximately 45° F., until such time as they were needed in the display cases. They were not iced while in the refrigerator. The investigator went to the store early each morning and selected fresh samples as they were being arranged for the day's display. Three samples of equal quality and size were weighed out. One was placed at the end of the non-refrigerated rack in a wire basket; the second was placed in the adjacent end of the snow-iced unit, also in a wire basket. These were left so displayed for 8 hours. The third sample was carried directly to the laboratory for analysis, just as a homemaker would have carried her purchase from the store to the kitchen—so that the ascorbic acid content of the original sample was comparable with that in a vegetable purchased by an early morning shopper. The store temperatures during the days of observation ranged from 70°-76° F. in the mornings and from 74°-86° F. in the afternoons. The two samples left on display for 8 hours were taken to the laboratory in the evening and analyzed immediately.

Reduced ascorbic acid (vitamin C) was determined in the vegetables by the methods of Bessey (1933, 1938) as modified by Morell (1941).

TABLE 1—*Average ascorbic acid content of leaf lettuce, green beans, and spinach before and after display for 8 hours on snow-ice and at room temperature.*

Vegetable	Weight basis on which data were calculated	Ascorbic acid content before display	After display for 8 hours on			
			Belshaw Vitamin-Sealed snow-ice display unit		Conventional sheet-iron rack	
			Ascorbic acid content	Loss or gain of ascorbic acid	Ascorbic acid content	Loss or gain of ascorbic acid
		mg./100 gm.	mg./100 gm.	percent	mg./100 gm.	percent
Leaf lettuce	Fresh	9.9	10.8		7.8	
	Dry	157	181	15.3	123	−21.7
Green beans	Fresh	14.5	14.1		13.4	
	Dry	155	151	−2.6	138	−11.0
Spinach	Fresh	35.0	32.3		20.4	
	Dry	520	502	−3.5	287	−44.8

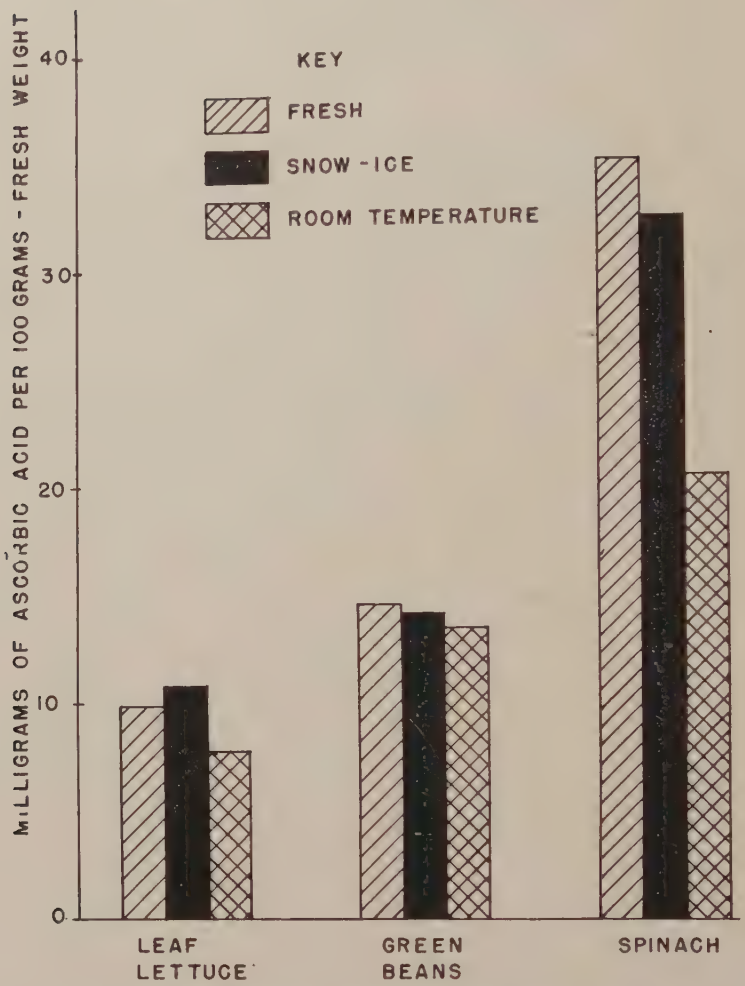


Fig. 1 Ascorbic acid content calculated on fresh weight basis of vegetables before and after storage on snow-ice and at room temperature.

Readings were made in a Coleman spectrophotometer. The samples were carefully and rapidly handled throughout the laboratory work. They were first washed in distilled water and dried with cheesecloth. Lettuce and spinach were cut in squares of about one-half inch and green beans in one-half inch lengths. Cut samples were placed in a large sack, and mixed thoroughly by shaking. Twenty-gram samples were weighed to the nearest 0.1 gram and immediately immersed in 100 milliliters of 3-percent metaphosphoric acid, ready for the ascorbic acid determinations. Samples for moisture determinations were weighed and dried at 90°-100° C. in a forced-draft oven. Lettuce and spinach were dried for 24 hours; green beans for 48 hours.

RESULTS AND DISCUSSION

The average vitamin C (ascorbic acid) values of the three green vegetables sampled before and after 8 hours of display with and without snow-ice are presented in Table 1 and Figs. 1 and 2. Each aver-

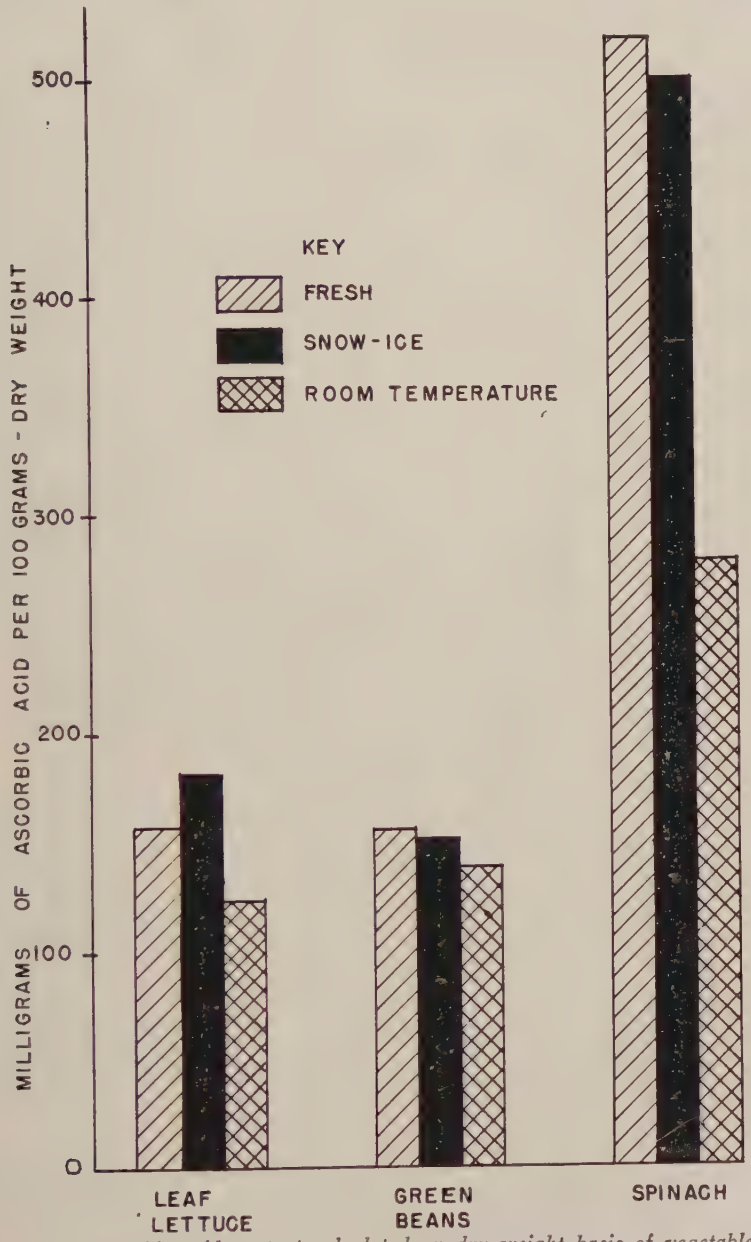


Fig. 2 Ascorbic acid content calculated on dry weight basis of vegetables before and after storage on snow-ice and at room temperature.

age in the table represents 12 samples upon which three ascorbic determinations were made. The ascorbic acid values were calculated on both the fresh and dry weight bases.

Calculated on the dry weight basis, leaf lettuce contained 157 milligrams of ascorbic acid per 100 grams of tissue. It did not lose any ascorbic acid when displayed for 8 hours on snow-ice; in fact, the average values for the samples displayed in this way were about 15 percent higher in ascorbic acid than the original samples. Leaf lettuce, displayed on an ordinary sheet-iron rack, lost 21.7 percent of its ascorbic acid in 8 hours (Table 1, Fig. 3). Green beans containing originally 155 milligrams of ascorbic acid in 100 grams of dry tissue, lost 2.6 percent of their ascorbic acid on the snow-ice as compared with 11.0 percent

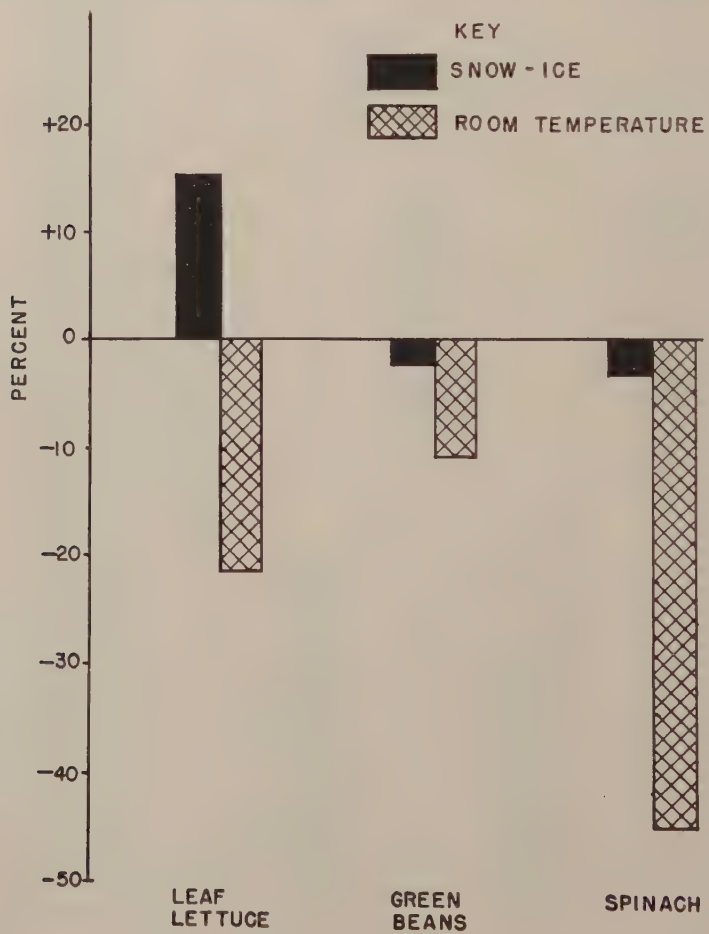


Fig. 3. Apparent gain or loss in the ascorbic acid content of vegetables stored on snow-ice and at room temperature.

on the conventional display rack. Spinach contained the highest amount of ascorbic acid of the three vegetables studied, 520 milligrams per 100 grams of dry tissue. Spinach also showed the greatest effect of the snow-ice; it lost only 3.5 percent of its total vitamin C on snow-ice compared with 44.8 percent on the ordinary display rack. These data consistently show that the effect of displaying vegetables on snow-ice in a retail grocery is to preserve and retain their original ascorbic content. The appearance of the vegetables is fresher and more acceptable when displayed on snow-ice. The favorable effects of snow-ice display were probably due to relatively low temperature and high humidity.

SUMMARY

For periods of eight hours, leaf lettuce, green beans, and spinach were displayed in a retail grocery store in two ways: on a conventional sheet-iron rack and in a Belshaw Vitamin-sealed Snow-ice System display unit. Twelve samples were analyzed in triplicate, for each vegetable.

Ascorbic acid was lost rapidly from all these vegetables when displayed without ice at room temperature; ascorbic acid was retained better in the same vegetable when displayed on snow-ice.

The quality and appearance of the vegetables displayed on snow-ice were better than those of vegetables held at room temperature.

LITERATURE CITED

Bessey, O. A. and King, C. G. 1933. The distribution of vitamin C in plants and animal tissues, and its determination. J. Biol. Chem. *103:* 687-698

Bessey, O. A. 1938. A method for the determination of small quantities of ascorbic acid and dehydroscorbic acid in turbid and colored solutions in the presence of other reducing substances. J. Biol. Chem. *126:* 771-784

Morell, S. A. 1941. Rapid photometric determination of ascorbic acid in plant materials. Ind. Eng. Chem. Anal. Ed. *13:* 793-794

Tressler, D. K., Mack, G. L., and King, C. G. 1936. Vitamin C content of vegetables I. Spinach. Food Res. *1:* 3-7

Wheeler, K., Tressler, D. K., and King, C. G. 1939. Vitamin C content of vegetables. XII. Broccoli, cauliflower, endive, cantaloup, parsnips, New Zealand spinach, Kohlrabi, lettuce and kale. Food Res. *4:* 593-604

Zepplin, M. and Elvehjem, C. A. 1944. Effect of refrigeration on retention of ascorbic acid in vegetables. Food Research *9:* 100-111

THE AGRICULTURAL VENEER CONTAINER INDUSTRY IN SOUTHERN MICHIGAN

By R. C. JOHNSON
SECTION OF FORESTRY
Lake States Forest Experiment Station and Michigan State College cooperating

MICHIGAN FARMERS use from 10 to 15 million veneer containers each year, depending upon the abundance of their crops. As many as 25 million containers could be produced in the assembly factories already established in Lower Michigan if these factories were all operated at full capacity. This industry is of considerable advantage to the farmers of Lower Michigan since it cannot only furnish a supply of containers closely geared to farm production but also because it is based largely on the use of products from farm woodlots. The industry has made it possible for farmers in the vicinity of the factories to obtain greater income from their woodlots because of the more diversified market provided for farm timber. This is especially evident in the case of such species as elm, cottonwood, soft maple, and beech which bring only a small return when sold for lumber, but bring almost double the amount when used for container veneer. In addition to the marketing advantages, farmers can also increase their income through the use of their own labor in logging their woodlots for these products and through part-time winter work in the factories.

Both because of the possible serious shortage of containers to market farm crops in 1944 and the overall importance of the veneer container industry to farm forestry in southern Michigan this industry has been made the subject of a special study by the author. This article is the second* one published in this study and pertains to the importance of the container industry to farm forestry in southern Michigan.

THE INDUSTRY

The agricultural veneer container industry represents a distinct segment of the container industry. It is practically the only container industry using veneer produced in southern Michigan, in contrast to

*The first report entitled "The Outlook for Agricultural Veneer Containers in Southern Michigan—1944" was published in May 1944 as Economic Note No. 20 by the Lake States Forest Experiment Station and as Article 26-60, Vol. 26, No. 4 in the Michigan Agricultural Experiment Station Quarterly Bulletin.

(Article 27-40)

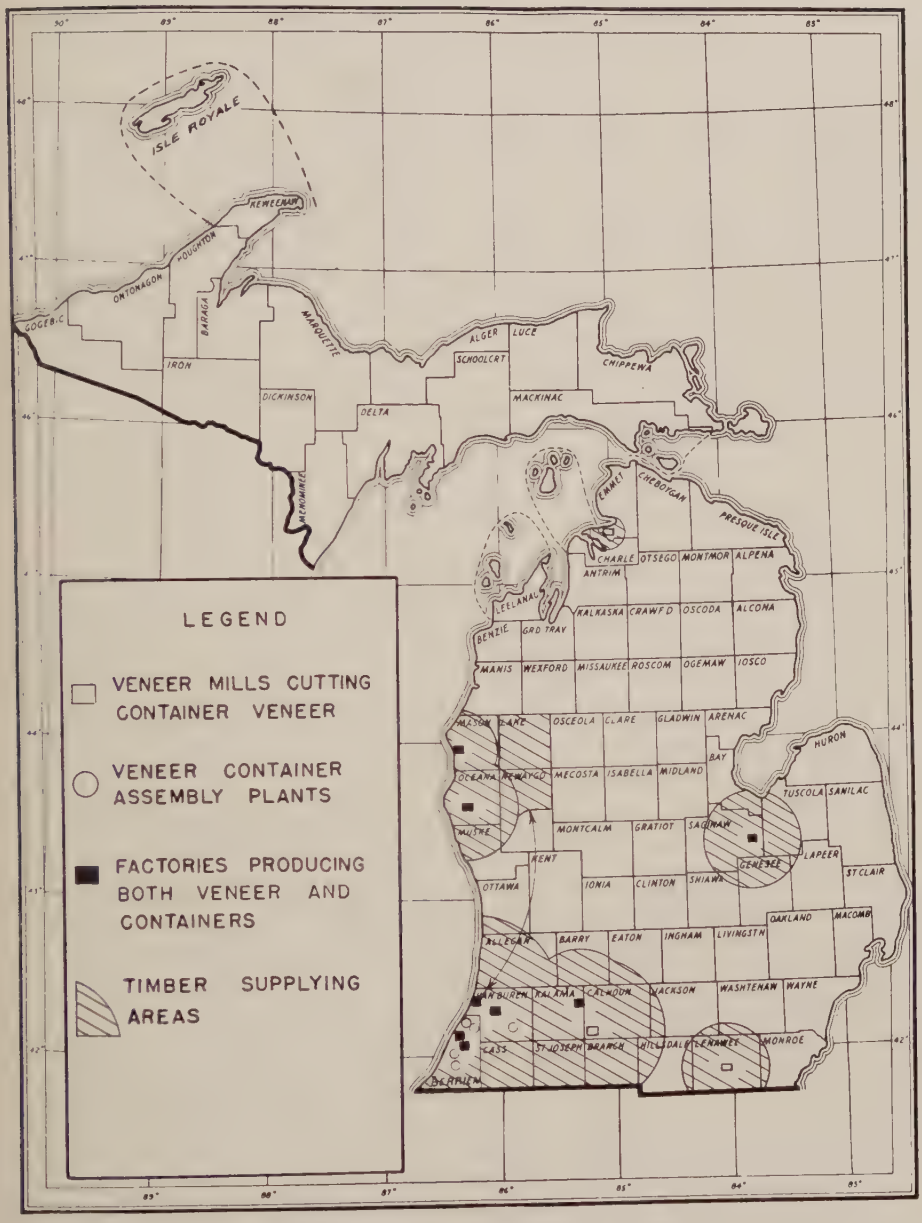


Fig. 1. Location of agricultural veneer container industries and timber supplying areas in southern Michigan.

the industrial container industry which uses West Coast plywoods and outstate veneers.

The principal products are fruit and vegetable containers. The most important containers are bushel and half-bushel baskets, 24-pint and 16-quart berry crates and 4- and 12-quart climax baskets.

In addition to those containers, smaller quantities of blueberry crates, partial veneer bushel boxes, melon crates, and celery crates are produced. Veneer plant bands for transplant and greenhouse use are also produced in considerable quantity. One Michigan factory produces cheese boxes. Egg cases are another agricultural container commonly made partially of veneer, but no Michigan factories are known to be producing egg cases from Michigan-produced veneer at present.

The industry is subdivided into two distinct operations: (1) veneer mills for cutting the veneer and (2) assembly plants for assembling the containers. Several of the factories carry on both operations, while others are engaged solely in the cutting of veneer or assembly.

VENEER PRODUCTION

Eleven veneer plants are known to be producing veneer for all types of agricultural containers. These plants vary in size from small family enterprises to large industries having more than 100 employees.

The manufacturing processes, however, are very similar in all cases. The logs are brought in from the woods in long lengths which are multiples of the bolt length to be handled on the lathes or so-called peelers. The logs are crosscut at the mill yard into bolt lengths, usually by a power drag saw. The bolts are then steamed in vats to improve veneering. Basswood and elm are sometimes veneered without steaming. Generally the bark is removed from the log before going into the lathe. All lathes producing veneer for containers are the rotary type. The bolts are scored with scoring knives as the bolt rotates to trim the veneer to proper length. The long-edged sheets of veneer then go through an automatic clipper to be cut to proper width.

The individual cuttings are then inspected for defects. At this point the good material is ready for drying or immediate assembly, depending on the type of container. Bushel baskets are assembled with fresh-cut veneer because of the better bending qualities. Veneer for climax baskets, on the other hand, needs to be partially dried to prevent excessive checking and splitting after assembly. The mills which are now producing veneer exclusively are not equipped adequately to dry the veneer and, consequently, concentrate on items for green assembly. In such cases the veneer cuttings are bundled and dipped in various chemicals to reduce staining and shipped immediately to assembly plants.

CONTAINER ASSEMBLY

There are 13 known assembly plants operating in southern Michigan. Here again, they vary from small family enterprises to large industries.

Equipment for assembling the numerous containers is so diversified that it is not possible in the scope of this article to describe in detail each assembly. Most of the assembly is machine work. A high degree of skill is required to operate the machines efficiently, and most of the assembly is paid for on a piece-work basis. The shortage of skilled machine operators has been one of the important reasons for declining production during the war.

PRODUCTION AND EMPLOYMENT DATA

In 1941 Michigan experienced one of its best fruit crop years on record. The veneer container industry, not yet hampered by lack of labor and other wartime problems, turned out record production. Production normally fluctuates considerably from year to year, depending upon the size of the fruit crops. Production data on containers are contained in Table 1.

TABLE 1—*Total capacity of the container assembly industry and actual annual production of containers for 1941-44*

Type of container	No. of companies in production	Maximum annual production	Production (thousand units)				1944 percentage of capacity
			1941	1942	1943	1944	
Bushel baskets*	6	7,335	4,644	4,244	3,330	3,370	46
½ bushel baskets*			120	96	48	30	
12-qt. climax baskets	8	7,300	2,935	2,300	1,668	1,375	19
4-qt. climax baskets	8	5,125	1,260	825	455	500	10
16-qt. crates*	10	4,000	954	677	487	525	19
24-pt. crates*			272	242	243	250	
16-pt. crates blueberry*	2	200	41	41	**77	71	35
12-pt. crates blueberry*							
Melon crates	1	500	200	125	75	100	20
Cauliflower crates	1	200	75	60	60	50	25
Bushel boxes	4	300	105	180	30	0	0
Cheese boxes	1	700	200	240	220	200	29

*Data combined because machines are interchangeable.
**Size changed by War Production Board order.

TABLE 2—*Total capacity of the container veneer mills and actual production of veneer for 1942-44*

Company groups	No. of companies	No. of lathes	Maximum annual production*	Production			1944 percentage of capacity
				1942	1943	1944	
			Million board feet				
Plants operating at or over 50% capacity	4	6	6.7	4.2	3.7	4.1	61
**Plants operating below 50% capacity	7	7	4.5	1.2	.5	.6	13
Totals for industry	11	13	11.2	5.4	4.2	4.7	42

*Based on 250 working days per year.
**Data includes a cheese box factory which was not included in the first report issued May 1944.

The industry used nearly 6 million board feet of Michigan timber in 1942. Of this, 5,400,000 board feet was made into veneer and 500,000 board feet into lumber. Practically all native species are used with the exception of oak. The principal species are elm, hard maple, soft maple, cottonwood, beach and basswood. Smaller quantities of tulip poplar, ash and sycamore are also used.

Prior to the war the industry obtained more than 3 million board feet of veneer annually from the South and West. These outstate supplies could not be obtained in such volume after the United States entry into the war. By 1943 outstate supplies declined to less than one million board feet of veneer. Michigan veneer mills had the machine capacity to make up for this shortage, but because of lack of labor their production actually declined. In 1944 Michigan veneer production recovered to nearly 5 million board feet of veneer.

Employment provided by veneer and container factories is not large when compared with other Michigan industries, but nevertheless it is important in the present factory areas. Prior to the war as many as

TABLE 3—*Number of employees in Michigan veneer and container factories*

Year	Number of Employees		
	Winter*	Summer**	Average for year
Average			
1938 to 1941	398	666	532
1942	379	495	437
1943	327	327	327
1944	304	340	322

*Winter season for basket factories averages November through April.
**Summer season for basket factories averages May through October.

700 men and women have been employed in just the veneer mills and container factories alone. Up to 100 loggers and log haulers have been needed to supply the logs.

IMPORTANCE TO AGRICULTURE

The container industry is beneficial to farmers and the state's agriculture in many ways. First, it has and will continue to furnish a dependable container supply for farm crops, especially the large fruit crops. It is true that container shortages have developed during the war, but Michigan manufacturers are to be commended for their concerted efforts to produce sufficient containers in spite of tremendous obstacles. The assembly plants are well equipped with sufficient machinery to meet even the largest bumper crop of fruits and vegetables. The factories operate on a limited schedule through the winter months until early spring when early predictions on the size of fruit crops can be made. From then on they expand their operations to produce about what the container market is expected to take. This close coordination of container production to size of fruit crops saves the grower money in that excessive inventories do not have to be carried and other expenses can be held to a minimum.

The Michigan container factories, in spite of paying higher stumpage and wages, have competed strongly with outside areas. The competition has been so keen, in fact, that many southern companies have given up trying to hold extensive Michigan markets.

The industry provides an excellent market for farm timber, especially for those species which have low lumber values. When outstate containers come in, no stumpage value goes back to the farmer and a source of part-time employment is also lost.

The industry can provide an excellent means of helping to put farm woodlots on sustained yield through selective logging for veneer quality logs. One large veneer mill has within the past year adopted selective logging almost exclusively. Only veneer and No. 1 quality logs are brought to the veneer mill. The No. 2 logs are sold to sawmills in the area. Diameter cutting limits are observed. The owner of the company stated that he gets a higher yield of better quality veneer with less labor. These factors will weigh heavily in the competition of the post-war era. This veneer mill is pointing the way toward better woodlot management.

FUTURE OF THE INDUSTRY

After the war the veneer container industry will undoubtedly be confronted with serious competition from other areas as well as from different types of containers. The competition of outside areas was

TABLE 4—*Hourly wage rates by labor classes for the years 1941 to 1944 in Michigan container industry*

Type of labor	Hourly wage scale in cents														
	1941			1942			1943			1944 Winter			1944 Summer		
	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average
Common labor.....	40	30	35	45	30	40	55	35	45	55	40	45	55	40	50
Machine operators and other piece work.....	70	45	52	75	50	55	75	50	60	80	50	65	80	55	70
Skilled labor*.....	65	40	50	65	40	52	70	50	60	70	50	60	75	50	65

*Not on production basis, maintenance supervision, etc.

being met before the war and, with more efficient production lessons being learned daily, the industry should be able to continue to hold Michigan markets. Labor and wages are the most unpredictable factors in the post-war period. They present possibly the most difficult problems of the industry.

Wages have increased as much as 50 percent over the low wages prevailing before the war. Even so, the wage scale is perhaps the lowest of the local industries, including farm labor. Since the largest veneer and assembly factories are located near industrial towns, competition, especially for the better type of labor, may continue in the post-war period, forcing still higher wages.

How the labor picture will shape up in the South is still uncertain, but as late as a year ago one large company was objecting to an order of the Wage and Hour Division of the Department of Labor raising the wages from a minimum of 35 cents to 40 cents per hour under the Provisions of the Fair Labor Standards Act of 1938.

The solution of the wage problem is not to be found in increased post-war container prices. Container prices have increased beyond a safe competitive point already. Further increase would definitely encourage outside competition and new types of containers.

There seems to be a good opportunity now to expand veneer production in southern Michigan to supply more completely the assembly plant needs in the post-war period. One veneer mill in particular which started as a working unit in 1944 points a way for expanded veneer production. This mill is located near Petoskey in the northern part of the Lower Peninsula. It is far enough removed from the present

mills to open up a new logging area to veneer production. Timber supply of the desired species is plentiful and stumpage prices have not been competitively pushed as high as they are in the main veneer producing areas. At the same time stumpage prices that can be offered by the veneer mill are better for many of the species than the lumber market.

There is room for several small veneer mills in the eastern half of the Lower Peninsula. Dispersing several small veneer mills in this area would be beneficial to farm woodlot owners. The new units would have to meet the competition which again will come in from the South. This means that drying equipment, especially, will have to be a part of at least some of the installations. The wage differential between Michigan and the South can be partially overcome by locating the mills in small towns, especially in the submarginal farm areas where permanent small wood-using industries are needed to help support subsistence farmers and to make full use of the timber resources of the state.

In addition to the markets for veneer in the fruit and vegetable container field an extensive market could be built up in egg case production. With the large quantities of cheap aspen which are available in the northern part of the Lower Peninsula for the lumber items in egg cases, it would seem that southern Michigan could meet outside competition.

New container types were beginning to give tough competition before the war and technological developments, resulting from stimulated war research, present a competition problem that is difficult to predict at the present. Just previous to the war the western apple box, a sawed shook box for the most part, was gaining rapid favor among growers and larger fruit packers. In 1942 almost one million of these containers were used to pack apples and peaches. This container has not been available in appreciable quantities since, but it will definitely be a post-war competitor. The container factories have been experimenting with a box built rather largely of veneer. Several designs have been developed but none as yet seem to have met the competition problem.

New developments in the waterproofing of paperboard makes it entirely possible that paperboard will make a strong bid for the veneer container business. Paperboard was being used to a limited extent for apple boxes and climax baskets before the war, but it was not entirely successful because of its weakness when wet.

Still another new development is the use of plastics to make pint and quart cups for berries. The advantage claimed for this container is that it can be washed like a dish and used over again or used as a household refrigerator container. The cost of a simple moulding process

might prove cheaper than the present-day piece cutting and individual assembly of veneer berry cups. Too little is known as yet about the cost of the plastic to make a comparison with that of veneer.

Cost of the container to the grower, serviceability, and appearance to help market the farm product are all going to be important factors in this competitive race. Even though the present-day basket factory is highly efficient, still more efficient systems will have to be devised to mechanize many of the hand operations and reduce handling costs all along the line. Scarcity of labor during the war has brought about many labor-saving devices too numerous to enumerate here. Other opportunities for labor-saving devices have been seen. These await only time and the necessary machinery to be put into operation.

Fruit crop trends in Michigan indicate that post-war container needs will be large. Some shift in container types which are already underway may continue. Strawberries and raspberries have been declining quite rapidly in recent years. If this trend continues fewer berry crates will be needed. The strawberry and raspberry crops can make a quick comeback, however, because of the short period between planting and bearing. Peach potentials are increasing and will continue to increase at least for a few years as the extensive younger plantings come into full production. More bushel baskets may be needed for this crop. Apples have been holding steady. The overall prospects for container markets is encouraging.

Marketing trends and theories on coming marketing methods seem to point toward wider distribution of tree-ripened fruit for fresh consumption. Air transport is definitely a possibility. If more and more fruit is sold for fresh consumption container needs will increase.

NEW OUTLETS FOR VENEER

Agricultural containers constitute only one of the possible outlets for southern Michigan veneer mills. Some of the timber in southern Michigan is of superior quality and yields high quality veneer. These high quality veneers if properly manufactured should find a ready outlet in the furniture and allied markets. New developments in veneers and plywood and their constantly increased use should open new possibilities for the veneer produced in southern Michigan. Agricultural veneer containers may serve to establish a greatly expanded veneer business in southern Michigan.

CONCLUSIONS

1. The agricultural veneer container industry in southern Michigan is a relatively small industry, as industries go in this state, but it is highly important to the farm woodlot owner because of the good markets it provides for timber species which have a low value for lumber, the incentive it provides for selective logging, and the seasonal employment.

2. It would be highly desirable to increase container veneer production by the establishment of small scattered mills to supply the veneer which was formerly shipped in from the South and West. These small scattered veneer mills would save long log hauls and tap new reserves of timber and cheaper labor.

3. Competition both from other producing areas and from different types of containers will be severe in the post-war period. A few of the most evident needs of the industry to meet this competition are:

(a) More attention to selective logging of larger, better grade trees for the veneer mill. Much lost time and poor quality veneer, with a high proportion of rejection, results from small, low quality logs. The lower quality timber which should be cut in a selective logging operation could be sold as saw logs to nearby sawmills or used for the lumber items needed by the assembly plants.

(b) Installation of improved drying equipment to improve the qualities of veneer and reduce handling and transportation costs.

(c) Marketing high quality veneers from the best logs for higher value uses such as for furniture veneer. Such a diversified marketing system for veneer would combine the advantage of the high prices for top quality veneers and the market provided by containers for lower quality and small cuttings.

(d) Development of new types of containers to meet competition and changing marketing trends.

4. The agricultural veneer container industry may serve to develop greatly expanded veneer production in southern Michigan for other products. If so it would make a very noteworthy contribution to farm forestry through the better and more diversified markets provided.

EMULSIONS FOR HORTICULTURAL SPRAYS

(A *Progress Report*)

By E. J. MILLER, A. L. NEAL and V. R. GARDNER
SECTIONS OF AGRICULTURAL CHEMISTRY AND HORTICULTURE

THE IDEA of using wax emulsions for spraying nursery stock and other plant materials for the prevention of desiccation was put forth in the laboratories of the Section of Agricultural Chemistry of the Michigan Agricultural Experiment Station in 1931. Subsequently, much time and effort have been spent in developing and testing emulsion sprays for this and other horticultural purposes.

The practice of protecting newly transplanted nursery stock from desiccation or drying out is not a new one, but dates back to the early history of mankind. Theophrastus, a Greek writer, in 300 B.C. wrote in his treatise entitled, "Enquiry into Plants," concerning the care of transplanted trees, that "men try to help the tree by plastering it with mud and tying pieces of bark, reeds or something of the kind about it, so that it may not take cold or become dried up". Theophrastus' reference to the trees taking cold or drying up indicates that in those days, too, trees were lost through winter killing and desiccation.

It is interesting to note that more than 22 hundred years ago mud was used to coat trees, and one of the essential ingredients of a wax emulsion used today for coating nursery stock is bentonite, a colloidal clay which when wet is the very essence of mud. Likewise, the use of bark and reeds in those days has its counterpart in the present-day use of burlap and wrapping paper on tree trunks to prevent sunscald and borer injury. Nature, thousands of years before man, had protected plants by coating them with wax, as for example the wax coatings on the carnauba palm which enables it to survive long periods of drought.

In more recent years some nurserymen and planters have coated small nursery stock with wax or mixtures of waxes, resins and gums before placing in storage or at the time of transplanting. The late J. A. Neilson was largely responsible for the development and advancement of this practice. His early work at the Ontario Agricultural Experiment Station (1928) indicated that beneficial results were obtained by waxing cionwood, and small nursery stock such as sweet cherries and roses. On his arrival at the Michigan Station he continued his investigations, but soon realized there were limitations to the practice.

(Article 27-41)

The application of the melted waxes in the nursery or after transplanting was subject to certain difficulties and dangers; such as the necessity of keeping the temperature of the melted wax within limits, danger of injury to the plant through contact with overheated wax, and the possibility of the wax melting in hot weather and penetrating the plant tissue, thus causing injury and death of the plant. Losses due to each of these causes have been known to occur. There was, however, a still greater drawback, in that the application was limited to plants small enough to be quickly dipped in melted wax. It was practically impossible to wax large trees and shrubs. Attempts at spraying melted waxes had not met with success.

After due consideration the suggestion was made that the use of a wax emulsion should offer possibilities of meeting the requirements for a satisfactory solution of the problem. It was felt that if an emulsion of suitable composition could be developed it would be possible to apply it at ordinary atmospheric temperatures, using any standard spraying equipment from the small hand-power atomizers to high-pressure outfits, and it would then be possible to wax all sizes of stock from seedlings to large full-grown trees and shrubs. It was a fortunate happenstance that only a few months previously, announcement had been made of the availability for commercial use of new emulsifying agents for waxes. Previous to that time it had been practically impossible to produce satisfactory and stable wax emulsions for industrial purposes. Emulsions of different waxes, and mixtures of waxes, resins, and gums were, therefore, prepared in the laboratory and tested on small plants in the laboratory and greenhouse. Eventually, after hundreds of emulsions had been prepared and tested, a new type of wax emulsion was developed that has proved very effective where the prevention of excessive drying out or desiccation will enable the transplanted stock to survive and become established.

This wax emulsion, known commercially as "Dowax," consists essentially of microscopic particles of paraffin wax suspended in water carrying a colloidal clay, and also an emulsifier which is necessary to keep the wax particles in suspension. The function of this colloidal clay, which is the mineral bentonite, is to provide a lattice or framework for the paraffin particles so that when applied to plants they will not melt in hot weather and penetrate the plant tissue and thus injure or kill the plant. In the dry film on the plant the paraffin particles are held in the clay framework much like bricks in mortar. The clay framework imparts to the film a sufficient porosity to permit passage of necessary gases for adequate respiration and yet the film as a whole retards or prevents excessive drying out.

Through the cooperation of The Dow Chemical Company several

large-scale experiments were arranged to determine the potential usefulness of Dowax.* These tests were carried out in some of the large commercial nurseries, and with the cooperation of highway and park commissions, on highway and park plantings in various locations around the state. Results of these tests seemed to indicate clearly that the emulsion would be valuable commercially under many conditions where the prevention of desiccation or drying out of plants would cut down losses.

Spectacular results were obtained in many cases, but space does not permit of detailed presentation of them. Suffice it to mention one instance, for example, which involved the fall planting of seven-foot white pine trees in a wind-swept area. The following spring there was 100-percent survival of sprayed trees contrasted with 100-percent loss of the untreated ones.

A brief summary (1) of the possible uses of Dowax (2) is as follows: Coating of deciduous, evergreen ornamental and fruit nursery stock before storing or at the time of transplanting. Coating of full grown forest trees after transplanting. Protection and stimulation of backward, transplanted trees and shrubs. Coating of trees and shrubs for successful transplanting during summer and fall. Prevention of summer sunscald on newly planted trees. Spraying of evergreens in the fall to prevent winter injury and browning of foliage. Coating of cionwood for grafts before placing in storage or at the time of setting. Coating of annual and perennial plants before transplanting. Control of San Jose and oyster-shell scale under certain special conditions. Carrier for insecticides and fungicides. Coating of Christmas trees (susceptible varieties) to prevent needle fall. Coating of stems and foliage of large, cut chrysanthemums to retard wilting. On some of these suggested uses much evidence has been obtained; on others there is need for further experimental work before the practical value of the procedure can be evaluated.

Although this wax emulsion was designed for use on dormant nursery stock the desirability and usefulness of an emulsion that could be applied on plants, shrubs, and trees during the periods of growth became obvious. After extensive tests on many different plants under various conditions, it was observed that under certain circumstances foliage injury resulted from the use of this emulsion. Experiments, therefore, were undertaken to determine the cause of the injury to foliage and to formulate an emulsion that would be satisfactory from both the physical and biological standpoints. It was also desired to utilize, if possible, ingredients from agricultural sources in the emulsion.

*Trade name of emulsion described in U. S. Patent No. 2,013,063, assigned to the Michigan State Board of Agriculture. The Dow Chemical Company is licensed to manufacture and distribute products based on this patent.

FORMULATION OF NEW EMULSIONS

The toxic action of the emulsion on foliage was soon found to be caused principally by the emulsifier, ammonium linoleate. Since this emulsifier appeared to be the only one commercially available that would produce an emulsion that would form a satisfactory film or coating on drying, the problem was not an easy one to solve. After considerable experimentation it was found possible to decrease the amount of the toxic emulsifier by the use of soybean protein and to substitute for a part of the paraffin wax a mixture of specially treated soybean, linseed and castor oils, all of which were from agricultural sources. This emulsion apparently had considerable promise. Its toxicity seemed negligible as compared with that of the previous wax emulsion, and it gave a smooth, transparent, inconspicuous film that in laboratory tests during the winter, reduced water loss on plants satisfactorily.

In extensive outdoor trials during the following spring and summer, however, it was found that the film produced by the new emulsion had several drawbacks. In the first place, the reduction of transpiration or water loss was relatively transitory, lasting only a few days, and after a matter of weeks and months the coating became brittle and peeled off, particularly on broad leaves that were flexed by wind and presumably on evergreen needles also by the expansion and contraction of both plant and film caused by changes in temperature.

It was therefore necessary to start anew in the search for a more satisfactory product. Again after much research a partial elimination of the difficulties was effected. It was found that an entirely different type of emulsifier, triethanolamine stearate, could be used with the wax-oil mixture-bentonite combination. This emulsifier had been previously tried but in the amounts apparently required, the resulting film was too easily decomposed by the action of water and on plants outdoors would soon be disintegrated by rain. By the adaptation of new, more effective, high speed emulsifying equipment (3) it was found possible to reduce the quantity of emulsifier necessary for the production of a stable emulsion to such an extent that it no longer adversely effected the properties of the resulting film. Moreover, it became possible to formulate emulsions that would yield films of practically any degree of permeability desired and which would be effective over longer periods of time.

ACCELERATED TESTS FOR EVALUATING EMULSIONS

Progress in the research on this project was painfully slow because of the fact that preliminary testing of the properties of these emulsions in fall, winter and spring could be done only on plant materials in the laboratory and in the greenhouse. Results thus obtained could not be relied upon or be translated into results that might be expected where the material was used on plants outdoors during the growing season under widely different conditions of temperature, humidity, moisture, etc. In order to eliminate these difficulties and make it possible to obtain a reasonably accurate estimate of the probable performance of emulsions outdoors, two laboratory procedures and apparatus were devised that have greatly expanded the number of emulsions that could be evaluated without awaiting field tests. These procedures are (a) a method (4) for the determination of permeability of agricultural spray coatings to water vapor and (b) a method for the evaluation of foliage injury and water loss in connection with use of wax and oil emulsions.

METHOD FOR THE DETERMINATION OF PERMEABILITY OF AGRICULTURAL SPRAY COATINGS TO WATER VAPOR

A method was devised whereby the amount of water vapor that would pass through a given area of film under conditions that were rigidly controlled could be accurately determined. Limitation of space here precludes a detailed description of the apparatus and method, and the original publication (4) should be consulted for a full description. Suffice it to state that the method affords a means of obtaining information helpful in the formulation of emulsions for the production of films of desired physical properties. It yields information of a quantitative rather than of a qualitative nature. Thus the effect of the incorporation of bentonite in the emulsions and of varying proportions of wax and oil in them on the permeability of the resultant films to water vapor may be determined.

A new method is now being developed which will not only greatly shorten the time involved in a determination, but also will permit repeated determinations on one coated disk without removing it from the apparatus. It is hoped that this method may be applicable to the direct study of the loss of water from a sprayed leaf rather than a coated disk (5).

EVALUATION OF FOLIAGE INJURY AND WATER LOSS

Satisfactory biological studies of the effect of spray materials on plants could not be made unless it was possible to eliminate the variations which plants are subjected to when grown under greenhouse or field conditions. Therefore as a means of conducting the toxicity and the transpiration studies under closely controlled conditions of light intensity, temperature and humidity, an environment chamber was constructed. Specific details of the apparatus and results obtained in these studies are reported elsewhere (6) and, therefore, will not be repeated here.

The study of necrotic areas of leaves sprayed with emulsions and kept in the chamber has been greatly facilitated by means of infra-red photography, since chlorophyll absorbs only to a slight extent the near infra-red radiations while the necrotic areas where chlorophyll has been degraded absorb appreciable quantities of these radiations. Hence this method of examination was used and found to be much more satisfactory than was visual observation or photography with visible light.

EMULSIONS USED IN FIELD TESTS

As stated previously, by means of the foregoing techniques an emulsion was formulated that seemed to have the necessary qualifications of being non-injurious to growing plants, of decreasing transpiration to the desired extent for a sufficiently long period of time, and of producing a film that is transparent and inconspicuous. These properties were amply demonstrated in trials in the controlled environment chamber and in the field. This emulsion, nevertheless, possesses certain limitations that operate against its satisfactory use commercially on a large scale. It could not be diluted with hard water without breaking, and it is necessary to ship the bentonite in a separate container and incorporate it with the water to be used in diluting the concentrated emulsion for use in the field. In the laboratory where small quantities are prepared these difficulties do not arise because distilled water is used. This emulsion was designated as T.S.S. and will be referred to again later on, for it has been used in extensive field tests.

Efforts were again turned to a solution of these difficulties and to formulate an emulsion that could be shipped in one container and could be diluted with hard water without breaking. These efforts as far as the production of a transpiration reducing spray is concerned have not as yet been wholly successful. In the course of the work, however, one emulsion was found to have properties that seemed to qualify it ideally as a sticker for insecticides and fungicides. This emulsion can

TABLE 1—*Spray residue data on apple leaves*

Date sample collected	Plot No.	Treatment*	Fresh leaves			Percent, dry weight			Percent increase		
			Number	Weight	Percent water	As_2O_3	Pb	S	As_2O_3	Pb	S
				Gram							
June 13....**....	1	A	183	31.2	66.58	0.111	0.272	1.098	85.6	60.3	108
	2	B	205	37.2	66.06	0.206	0.436	2.286			
Nov. 2.....	1	A	122	35.5	65.03	0.097	0.211	0.406	104	94.5	12.1
	2	B	89	33.3	64.20	0.198	0.419	0.455			
June 13**.....	3	A	200	33.3	65.39	0.098	0.191	0.849	73.5	76.9	158
	4	B	191	32.4	65.95	0.170	0.338	2.188			
Nov. 2.....	3	A	91	32.2	61.87	0.042	0.084	0.118	23.8	117	175
	4	B	107	37.9	61.34	0.052	0.182	0.325			
June 13**.....	5	A	211	35.4	64.78	0.068	0.114	0.664	23.5	86.0	142
	6	B	196	40.1	65.63	0.084	0.212	1.504			
Nov. 2.....	5	A	98	39.8	61.34	0.037	0.092	0.203	119	122	68
	6	B	113	39.2	63.44	0.081	0.205	0.341			
June 13**.....	7	A	215	47.8	67.10	0.094	0.204	1.033	98.3	85.7	89.2
	8	B	191	39.3	65.67	0.178	0.379	1.955			
Nov. 2.....	7	A	110	44.3	63.25	0.066	0.139	0.241	4.5	4.6	62.12
	8	B	82	46.2	62.12	0.069	0.203	0.239			

*A—fungicides only.
B—fungicides plus sticker D-82.
**Samples collected before spray-program completed.

be diluted to any desired degree with hard water and is not affected by any of a considerable number of insecticides and fungicides. It has been used in extensive field tests in different parts of the country with results that warrant further tests on still larger scale to determine its effectiveness in retaining insecticides and fungicides on foliage for long periods of time without being washed off by rain. If the materials retain their effectiveness for disease and insect control under these conditions, the use of this sticker will result in a considerable saving of time, labor, and expense to the grower.

In the large number of exploratory trials made during the summer of 1944 the sticker was used on the following garden plants and fruit and forest trees with the appropriate insecticides and fungicides, such as the arsenates, sulfur and copper compounds, for the control of various diseases and insect pests: apple, cherry, pear, grape, tomato, potato, melon, cucumber, squash, sweetpotato, cabbage, broccoli, bean, beet, peas, radishes, gladiolus, roses, and numerous other flowers. In many of the instances the results are very gratifying and even spectacular, but not all of them were under the observation of entomologists or plant pathologists, and they are for but a single season. It will be necessary, of course, to carry on the tests over a number of growing seasons before final evaluation can be accomplished.

An opportunity to study the weathering effect of the sticker presented itself in connection with a study being made by the Horticultural Department with respect to the effect of the sticker plus various fungicides when applied to apple trees. Samples of leaves from trees of the variously treated plots were collected and analyzed for spray residue. The results of the analyses are presented in Table 1 and show that there was considerably more retention of spray residue on the leaves sprayed with the emulsion sticker than there was on the control samples. An overall picture of the advantage of incorporating the sticker in the spray may be obtained by considering the weighted averages of the samples collected on November 2 after weathering over

TABLE 2—*Average increase in retention of spray residue**

Treatment	Percent total spray residue		
	Arsenic oxide	Lead	Sulfur
Control	0.176	0.387	0.727
Emulsion-treated	0.331	0.806	1.121
Difference	0.155	0.419	0.384
Percent increase over control	88	108	54

*Samples collected November 2, excluding Plots 7 and 8.

the summer period as shown in Table 2. In this calculation the results of the analyses of samples from Plots 7 and 8 were omitted as there is an apparent discrepancy which cannot be accounted for and it was impossible to check the values due to the fact that the analytical data were not available until after the leaves had fallen. It is apparent, however, that the sticker aids materially in effecting a retention of the fungicides used in this test. It is of interest to compare the results obtained from the analyses of Plots 1 and 6, collected November 2. Samples from the former plot which had received nine spray applications without the sticker contained only about 16 percent more arsenic oxide residue and 3 and 16 percent more lead and sulfur residue, respectively, than did Plot 6 which had been given five applications of the same chemicals plus the sticker. Thus, it appears that equivalent results from the standpoint of spray residue may be obtained from fewer treatments merely by the use of the sticker.

When bearing Montmorency cherry trees at orchards located near East Lansing were sprayed with a fungicide plus D-82 sticker a decided increase in the size of the fruit was noted. This difference in size was so apparent that even upon casual observation from some distance away the trees sprayed with the emulsion could be easily differentiated from the controls. A similar phenomenon was noted at the Graham Station orchards near Grand Rapids. It was found that this increase amounted to about 7 percent where one application of the spray was applied and approximately 15 and 35 percent, respectively, when two and three applications were made. There was, however, no significant difference in the sugar content of the cherries from the variously treated plots, a fact which would indicate a continued normal development of the fruit beyond that of the controls. As a result of this unexpected finding, extensive tests have been planned in order to determine the advisability of using the sticker on a commercial scale for increasing the size of this fruit.

In order to test the applicability of the sticker under various climatic conditions samples were sent to several experiment stations throughout the country and also to Brazil. Since a complete report has not been received as yet from each of the consignees, only a brief summary of the data at hand will be presented. It was found that by incorporating the sticker in a lead arsenate spray the protection from flea beetles on tomato was increased 20-25 percent above that of lead arsenate alone and that the period of absolute freedom from Japanese beetle on Virginia creeper and derris was almost twice as great as when summer oil and lead arsenate were used. It was also noted that protection of string beans against rabbits was increased markedly when the sticker was used in conjunction with Black Leaf 155. Comparison experiments dealing

with the control of Japanese beetles on elm and linden trees were not conclusive due to the abnormally low infestation by these beetles in the location where tested as well as the relatively low rainfall. In a series of experiments designed to determine the adhesion of a fixed copper fungicide on tomato, the oil-wax emulsion sticker showed no advantage over several of the other stickers included in the experiment.

Extensive tests over a long period of time will have to be completed in order to determine the advantages of the wax-oil emulsion sticker over commercial products as well as to determine its limitations. Until all of these data are compiled, it will be impossible to recommend that this oil-emulsion be applied on a large scale whenever a sticker is desired, but on the other hand, it should be used only on a portion of the plants under examination, and the remainder of the plot treated as usual.

USE OF T.S.S. AS A BLOSSOM CONTROL SPRAY

Apple growers are well aware of the fact that they must consider four main practices if large annual corps of high-grade fruit are to be obtained. *First*, they must employ good soil management methods. This may mean cultivation or mulching, depending upon the conditions, and often the application of suitable fertilizers are necessary. *Second*, they must prune the trees to remove dead or inferior type wood that bears low-grade fruit and must keep their trees in proper shape. *Third*, they must protect foliage and fruit from insects and disease attack by means of spraying or dusting. *Fourth*, whenever there is a tendency on the part of the trees to overbear, they must thin the crop, otherwise, the trees will overbear one year and the fruit will be under-sized and inferior in grade and then the following year is likely to be an off year with no crop.

On the whole, apple growers in Michigan and in other eastern states are thoroughly convinced of the necessity of good soil management practices, of pruning and of spraying or dusting and, in the great majority of cases, a satisfactory procedure is used. On the other hand, thinning of fruit on trees that set too heavy a crop is not generally employed as an orchard practice. One reason for the limited practice of thinning apple trees is its relatively high cost and the fact that it requires a large amount of hand labor for a comparatively short period of time. Under the conditions of the past 2 years, it has been almost impossible for many producers to obtain the necessary labor required, and this condition is likely to continue during the next year or two, if not longer. A quicker, less expensive method of thinning the fruit either at blossoming time or later, therefore, is desirable.

Attempts to thin fruits, particularly apples, at the blossom stage through the use of caustic sprays have been made during the past 10 or 12 years. Many materials have been tried with more or less success and the two groups of chemicals which have been found to be most satisfactory to date are the dinitrophenol and the dinitrocresol derivatives. These, however, are caustic sprays. They, to a certain degree, literally burn off the blossoms, and while so doing cause appreciable injury to the young leaves that are out at the time and often adversely affect the fruit spurs and twigs. Their effects vary from season to season, from variety to variety, and likewise vary with environmental conditions and with the vigor of the trees. Although they are conditionally recommended for use under certain conditions, their application is attended with much risk; hence, a safer and a more certain procedure would be desirable.

With those facts in mind, it appeared that the wax-oil emulsion would be suitable to use for thinning apples, not by killing the blossom, but merely by forming a coating over the stigmatic surfaces and thus preventing either pollination itself or pollen germination. This would

TABLE 3—*Harvest data for blossom control test*

Tree code	Number apples per spur				Apples per tree	Weight apples per tree
	One	Two	Three	Four		
	Apples per tree					*Pounds*
1-B	1,706	802	99	4	2,611	388
22-S	835	596	180	28	1,639	312
Total	2,541	1,398	279	32	4,250	700
Weighted average percent	60	33	6.6	0.75	.....	0.165 per apple
2-C	1,695	278	33	0	2,006	277
5-D	1,322	382	48	0	1,752	264
12-E	615	278	57	0	950	149
23-T	1,560	496	51	8	2,115	372
Total	5,192	1,426	189	8	6,823	1,062
Weighted average percent	76	21	2.9	0.12	.....	0.156 per apple
5-B	1,607	318	12	0	1,937	261
7-D	1,605	530	66	0	2,201	279
8-E	1,050	452	54	8	1,564	219
20-S	1,400	484	45	4	1,933	377
Total	5,662	1,784	177	12	7,635	1,136
Weighted average percent	74	23	2.3	0.16	.....	0.148 per apple

CODE KEY:
1-B, 22-S—controls, not sprayed.
2-C, 5-D, 12-E, 23-T—sprayed with a 1% suspension of T.S.S. without the addition of bentonite.
5-B, 7-D, 8-E, 20-S—sprayed with a 5% suspension of T.S.S. without the addition of bentonite.

be purely a mechanical effect and, therefore, would have to be applied at full bloom with the assurance that no injury would result to the blossoms which may have been pollinated before spraying.

A definite, substantial thinning of apples was obtained when Duchess trees were sprayed with the wax-oil emulsion T.S.S. (without the bentonite) during full bloom. Upon examining the harvest data presented in Table 3 it is apparent that the trees sprayed with the emulsion had appreciably more single apples per spur and fewer two, three and four apples per spur than did the controls. Also, it is interesting to note that a 1-percent concentration of the emulsion was as efficient in thinning the fruit as was a 5-percent concentration. Application of the Chi squared test in a statistical analysis of the results of the harvest data proved beyond a doubt that the effects produced by the spray treatment in each case were significant. Although only the one emulsion was tested for its effect upon thinning apples, it is quite possible that the sticker emulsion would also produce the desired effect, thus permitting the use of only one emulsion both for the thinning of apples or for a sticker for fungicides. The final answer to this question will, of course, depend upon the outcome of additional field tests.

RECOMMENDATIONS FOR TRIAL BLOSSOM CONTROL SPRAYING

Wholesale application of this material to entire orchards is not recommended, but on the other hand, what might be termed semi-commercial trials of the materials are in order. By a semi-commercial trial is meant the application of one or two spray tankfuls of the material, leaving, of course, the main portion of the orchard unsprayed.

There are different possible ways of making the application. For a general overall thinning a thorough application should be made so as to cover the entire tree. The suggestion is also made that what might be termed "spot" applications would be worth trying under some conditions. By a "spot" application is meant the extremely thorough spraying of several sections of large limbs of the tree while other sections or large limbs are left unsprayed. The idea here would be to thin drastically the crop on certain portions of the trees with the idea that they would bear again another year. Still a third method of application that would probably be more practicable under some conditions would be to spray the interior of the tree very thoroughly in an attempt to reduce the setting of fruit on the lower and interior limbs that ordinarily bear the smallest, most poorly colored fruit, thus reducing the number of culls. It would not, however, have much or any influence

in making the tree annual rather than biennial bearing, as would the other two methods of application.

Blossom spraying applications for the purpose of thinning the fruit are, of course, not suggested for varieties that normally are not inclined to set more than they can carry through to maturity satisfactorily. Delicious, Rhode Island Greening, Wolf River, Stayman Winesap and Rome, as these varieties ordinarily grow in Michigan, belong to this class. The treatment is suggested for varieties that are inclined to set very heavily or to the alternate bearing habit, such as Yellow Transparent, Duchess, Wealthy, Grimes, Wagener, Baldwin, and Stark.

Since these aforementioned emulsions have been subjected to only preliminary tests and, consequently, their merits and limitations are not fully known, it is impossible to make more definite recommendations at the present time.

When a sticker is employed the question as to possible accentuated spray injury arises, owing to the fact that more of the chemicals are held in close contact with the foliage. More injury was noticed when cherry trees were sprayed three times with a copper fungicide plus the emulsion sticker, but not in the cases where only two applications were made. Hence, if the desired control can be obtained either by decreasing the number of spray applications or by decreasing the amount of chemical per application so that the total spray residue is less than that necessary for injury, this drawback will be overcome. Sulfur injury, such as occurs when abnormally high atmospheric temperatures prevail, was more pronounced on apple trees which were given several applications of this fungicide along with the sticker, than on the trees which were sprayed with sulfur only.

Extreme caution must be exercised when spraying after the fruit is fairly well developed in order that the spray residue on the fruit does not exceed government tolerance limits.

ACKNOWLEDGMENTS

This research was supported in part by the Horace H. Rackham Research Endowment of Michigan State College for studies on the industrial utilization of agricultural products.

The interest and active cooperation of many members of the staffs of the Sections of Botany, Chemistry, Entomology, and Horticulture in this research are gratefully acknowledged. Particular appreciation is due to the Ford Motor Company and The Dow Chemical Company for making large-scale quantities of emulsions and conducting extensive tests.

LITERATURE CITED

(1) Miller, E. J., J. A. Neilson, and Selma L. Bandemer, 1937. Wax emulsions for spraying nursery stock and other plant materials. Mich. Agr. Expt. Sta. Spec. Bul. 282.

(2) Miller, E. J., 1935. Method for the protection of plants. United States Patent No. 2,013,063. Sept. 3, 1935.

(3) Comar, C. L., E. J. Miller, M. N. Richard, and E. J. Benne, 1944. Adaptation of a Waring Blendor for continuous emulsification. Industrial and Engineering Chemistry, Analytical Edition, *16:* 717-719.

(4) Comar, C. L., and E. J. Miller, 1943. Determination of permeability of agricultural spray coatings to water vapor. Industrial and Engineering Chemistry, Analytical Edition, *15:* 737-740.

(5) Neal, A. L. Unpublished.

(6) Comar, C. L., and C. G. Barr, 1944. Evaluation of foliage injury and water loss in connection with use of wax and oil emulsions. Plant Physiology, *19:* 90-104.

THINNING APPLES WITH THE SODIUM SALT OF NAPHTHYL ACETIC ACID

*By J. H. DAVIDSON, O. H. HAMMER, C. A. REIMER, and W. C. DUTTON**

THINNING THE fruit of many varieties of apples is one of the most important but also one of the most expensive and laborious operations involved in apple production. These factors are responsible for the acute interest in the use of chemical sprays to thin fruit. Tar oils, DN-oil, straight petroleum oil, emulsions of vegetable oils and paraffin, etc., have been used with varying degrees of success. Dinitro ortho cyclo hexyl phenol and dinitro ortho cresol and some of its salts have been used rather extensively in experimental and commercial operations. This report discusses the use of the sodium salt of naphthyl acetic acid for this purpose. Fruit growers are familiar with this material used at harvest to reduce premature dropping of the fruit.

"Thinning" effects from this type of material have been reported by several investigators. Among these are Burkholder and McCown (1) and Greene (2) who observed such effects on apples in Indiana; Schneider and Enzie (3) who report thinning of apples in New Mexico, and Smith (4) who noted a reduction in the set of pecans from such treatment.

The results discussed in this report are from experiments carried on in the South Haven area of Michigan during 1941, 1942, 1943 and 1944. The first observation of thinning was in 1941, in an experiment in which the sodium salt of naphthyl acetic acid (widely distributed under the name "App-L-Set," but hereafter referred to as NaNAA) was used for a purpose entirely different from thinning. It was used at the concentration of 10 parts per million (0.001 percent) in combination with the materials regularly used for the control of apple scab and codling moth. This is the concentration most commonly used in harvest sprays. Four treatments were used: (1) wettable sulfur, (2) wettable sulfur and NaNAA, (3) wettable sulfur and hydrated lime, and (4) wettable sulfur, hydrated lime and NaNAA. The sulfur or sulfur and lime were used in pre-bloom applications and in the petal-fall and two cover sprays. Lead arsenate was used in the

*Staff members of the Horticultural Department of the Dow Chemical Company. This manuscript is made available to the readers of the Quarterly Bulletin through the courtesy of the Dow Chemical Company.

(Article 27-42)

petal-fall and several cover sprays. The NaNAA was used throughout the season in applications 2 and 4. These treatments were applied to Stark, Grimes Golden, McIntosh and Jonathan in one orchard and two of them to Golden Delicious in another. Since this work was not planned as a thinning experiment, no attention was given early in the season to the numbers of apples persistent on the trees. Before the season was over, however, it was observed that there were fewer apples on trees that had received several applications of NaNAA. No exact record of bloom is available but the trees were reasonably uniform in size and had rather heavy bloom. The number of apples per tree picked at the normal harvesting time is shown in Table 1.

TABLE 1—*Thinning effect of the sodium salt of naphthyl acetic acid, 1941*

Spray treatment	Apples per tree harvested				
	Stark	Grimes	McIntosh	Jonathan	Golden Delicious
Wettable sulfur	3,254	8,541	6,380	5,396	
Wettable sulfur NaNAA (10 ppm)	374	1,740	1,614	1,835	
Wettable sulfur Hydrated lime	4,507	9,194	4,949	5,527	6,897
Wettable sulfur Hydrated lime NaNAA (10 ppm)	427	970	2,471	1,485	1,022

These figures show very significant effects from repeated applications of NaNAA, none of which were applied while the trees were in bloom.

1942 EXPERIMENT

NaNAA was used in 1942 for thinning in one orchard of mature Grimes Golden at 10 and 20 parts per million in single applications in (1) the pink or open cluster stage, (2) at full bloom and (3) in the petal-fall application. It was used in all cases alone as special applications and never with sulfur or lead arsenate. Separate trees were used for checks. The treatments and results are shown in Table 2. The counts are shown as "apples per 100 spurs that bore blossoms."

These results show marked thinning from all treatments but with more severe thinning from 20 than 10 p.p.m. The full bloom application was more effective than either the open cluster or petal-fall treatments.

TABLE 2—*Thinning Grimes Golden with NaNAA, 1942*

Concentration of NaNAA	Apples harvested per 100 spurs when applied in		
	Open cluster	Full bloom	Petal-fall
10 ppm	14.0	8.5	19.5
20 ppm	6.0	1.9	6.5
Check	30.5	30.5	30.5

1943 EXPERIMENT

Further effort was made in 1943 to learn more about the effect of the concentration and time of application on the degree of thinning. This work was done on the Stark, Grimes, McIntosh and Jonathan trees used in 1941. NaNAA was used at 10 and 20 p.p.m. at (1) full bloom, (2) petal-fall, (3) first cover, (4) between first and second covers and (5) second cover. The NaNAA was used alone in treatments 1 and 4 and with wettable sulfur, hydrated lime and lead arsenate in treatments 2, 3 and 5. Separate check trees of each variety were used. The general set of fruit was reduced by frost injury. This was most severe on Stark. The results are shown in Table 3 as "apples per 100 spurs that blossomed." The final counts shown here were taken on July 20.

TABLE 3—*Thinning apples with NaNAA, 1943*

NaNAA applied in	Concentration	Apples per 100 spurs—July 20			
		Stark	Grimes	McIntosh	Jonathan
Full bloom	10 ppm	1.9	9.5	14.0	5.7
	20 ppm	0.03	3.7	6.9	0.07
Petal-fall	10 ppm	0.53	8.9	20.1	5.8
	20 ppm	0.6	4.4	16.5	1.2
First cover (2 weeks after petal-fall)	10 ppm	3.8	20.5	19.1	15.3
	20 ppm	2.2	10.7	15.1	6.5
Between first and second covers (3 weeks after petal-fall)	20 ppm	2.8	14.5	18.3	11.5
Second cover (4 weeks after petal-fall)	10 ppm	5.7	33.7	25.3	19.7
	20 ppm	4.9	25.6	29.0	17.7
Check	none	4.3	28.6	26.9	24.6

These results, although complicated by frost injury, show very definite trends. (1) Very little or no thinning resulted from the use of either 10 or 20 p.p.m. concentrations in the second cover spray (about 4 weeks after petal-fall). (2) Moderate thinning occurred when 20 p.p.m. were used about 3 weeks after petal-fall. (3) At 2 weeks after petal-fall, 10 p.p.m. caused less thinning than 20 p.p.m. at 3 weeks but 20 p.p.m. at 2 weeks caused more than 20 p.p.m. at 3 weeks. (4) There was a sharp increase in effect in the petal-fall from both concentrations on Grimes and Jonathan, but no increase over the 2 weeks' spray on McIntosh. 20 p.p.m. was more effective, however, in every case than 10 p.p.m. (5) The full bloom spray of 10 p.p.m. gave about the same results as that concentration in the petal-fall and 20 p.p.m. caused even more severe overthinning than in the petal-fall spray.

1944 EXPERIMENT

The varieties used in 1941, 1942, and 1943 are all now recognized as being rather easy to thin with chemical agents. Experiments in 1944 included Baldwin and Wealthy, which are generally more difficult to thin with sprays, as well as Grimes Golden. The Wealthy and Grimes trees were large and mature; the Baldwin trees were 18 to 20 years old. Records were taken from five sets of paired branches on each tree. The check branches were covered during spraying with large bags made from Kraft paper. Untreated Grimes set rather heavily but unsprayed Wealthy and Baldwin set only moderately heavy even with rather favorable pollinating conditions. Two concentrations of NaNAA (10 and 20 p.p.m.) were used at full bloom and in petal-fall applications. The NaNAA was used alone in all instances. Results expressed as "apples per 100 blossoming spurs" are presented in Table 4.

TABLE 4—*Results from NaNAA, 1944*

NaNAA applied in	Concentration	Apples per 100 spurs		
		Grimes	Wealthy	Baldwin
Full bloom	10 ppm	2.8	25.3	37.0
	Check	103.1	45.2	56.2
	20 ppm		7.6	31.0
	Check		43.6	74.8
Petal-fall	10 ppm	41.6	29.4	48.6
	Check	76.8	32.1	67.1
	20 ppm	27.9	33.3	26.4
	Check	70.3	43.5	40.1

These results are rather difficult to interpret, but a combination of general observations and the data give definite indications. (1) The full bloom spray of 10 p.p.m. took off practically the entire crop of Grimes. (2) The petal-fall spray of 10 p.p.m. gave moderate thinning of Grimes, while the use of 20 p.p.m. at that time resulted in a finely distributed crop of fruit. (3) The bloom on Wealthy was very heavy and the thinning from 10 p.p.m in bloom was very inadequate, but the use of 20 p.p.m at that time resulted in a well spaced crop of large apples. (4) Similar results were obtained on Baldwin from the full bloom spray. (5) Neither 10 nor 20 p.p.m. used in the petal-fall spray gave adequate thinning on Wealthy or Baldwin.

SUMMARY

NaNAA has produced marked thinning of the fruit of several varieties of apples. It was effective alone, with wettable sulfur, with wettable sulfur and hydrated lime and with lead arsenate present. Greatest thinning, sometimes too severe, occurred when applied at full bloom and applications just before or just after bloom were less effective than at full bloom but often adequate. Treatments made at two and three weeks after petal-fall were less effective than at petal-fall and an application four weeks after petal-fall apparently had no effect. Varietal responses vary greatly and a given variety apparently does not respond the same every year. Foliage injury has not been a factor in any case. Definite recommendations for the use of NaNAA cannot be made at this time but it may be possible to develop a combination of concentrations and application timing that will be satisfactory.

LITERATURE CITED

1. Burkholder, C. L. and McCown, Monroe. Effect of Scoring and of a-Naphthyl Acetic Acid and Amide Spray Upon Fruit Set and of the Spray Upon Preharvest Drop. Proc. Amer. Soc. Hort. Sci. *38:* 117-122. 1941.

2. Greene, Laurenz. Growth Regulators and Fruit Set with Starking Apples. Proc. Amer. Soc. Hort. Sci. *42:* 149-150. 1943.

3. Schneider, G. W. and Enzie, J. V. The Effect of Certain Chemicals on the Fruit Set of the Apple. Proc. Amer. Soc. Hort. Sci. *42:* 167-176. 1943.

4. Smith, C. L. Effect of Some Growth Chemicals on Premature Dropping and Development of Pecan Nuts. Proc. Amer. Soc. Hort. Sci. *44:* 119-122. 1944.

AN EXPERIMENT IN THE PLACEMENT OF ORCHARD FERTILIZERS

By T. A. MERRILL and GUY SPRINGER
Section of Horticulture

Changing from one method of orchard management to another often necessitates some changes in other practices to obtain the best results. During the past few years many orchardists in the state have changed from clean cultivation to the sod system of soil management. In many cases these individuals have applied their fertilizer with a spreader between the rows or by hand, covering the entire tree square or a large part of it.

When sod cover is used in the orchard it is going to compete with the trees for moisture and nutrients, especially nitrogen. In applying nitrogen fertilizer to trees growing in sod the trees will obtain a larger proportion of the nutrients when applied in a narrow band around the drip of the branches. This band should be confined to 12 to 18 inches in width, limiting the area covered and thus preventing the grass from consuming a large proportion of the nitrogen as it penetrates the upper portion of the soil before reaching the tree roots.

The accompanying photographs show two Montmorency cherry trees growing in a Kentucky bluegrass sod. The same amount of fertilizer was applied to the soil around each tree. However, tree No. 1 received sulfate of ammonia in a band application, while the fertilizer was applied to the area around tree No. 2 with a spreader, putting most of the nitrogen on the area between the trees where the grass was most vigorous. As a result, tree No. 2 did not obtain as much nitrogen as it could use to advantage because the grass absorbed it before it reached the tree roots, and tree growth was less vigorous. Tree No. 1 produced 1¾ more lugs of cherries than tree No. 2, which received insufficient available nitrogen.

(Article 27-43)

Fig. 1. Montmorency cherry tree (No. 1) growing in Kentucky bluegrass sod. Fertilizer applied as a band application. Note the density of the foliage as compared with that of tree No. 2.

Fig. 2. Montmorency cherry tree (No. 2) growing in Kentucky bluegrass sod. Fertilizer applied with a spreader between rows.

LACTIC ACID AND TITRATABLE ACIDITY OF COMMERCIAL DRIED AND EVAPORATED MILK IN MICHIGAN

By I. A. GOULD and F. M. SKIVER***

CONSIDERABLE INTEREST has been shown within recent years in the quality of concentrated milk products as determined by the lactic acid content. This has resulted because of the development of an accurate procedure for measuring lactic acid by Hillig (4) and because of the application of this method by regulatory officials to dried and evaporated milk. The basis for this quality measurement is that when milk is produced and handled improperly, some bacterial spoilage occurs, accompanied by lactic acid production. Thus, the amount of lactic acid in the milk indicates the degree of spoilage, and, correspondingly, lactic acid determinations on the manufactured product will indicate the quality of milk used in its manufacture.

Previous work (2, 4) has shown that the analysis of fresh milk by the Hillig technique results in an average value equivalent to about 0.002 percent lactic acid. Consequently, milk with a lactic acid content appreciably higher than 0.002 percent may be assumed to have undergone a certain degree of bacterial deterioration. In another study (3), results were obtained which revealed that those flavors of milk associated with acid production are detectable when the lactic acid content is somewhat less than 0.01 percent.

In view of the interest in the determination of quality in dried and evaporated milk by lactic acid measurements, it appeared desirable to ascertain the lactic acid content of commercial samples of such products in Michigan. The results obtained by such analyses constitute the basis for this paper.

EXPERIMENTAL

Samples of dried milk solids, not over 1½ percent fat (prepared for human consumption), and evaporated milk were obtained directly from various commercial plants of the state by the Michigan Bureau of Dairying. The samples represented freshly processed milk in every case so as to eliminate possible changes in composition due to storage.

*Former member of the Section of Dairying, now at the University of Maryland, College Park, Md.
**Director, Bureau of Dairying, State Department of Agriculture, Lansing.

(Article 27-44)

Also, in order to ascertain seasonal variations, dried and evaporated milk were obtained during mid-winter (January) and during mid-summer (July).

Lactic acid was determined by the Hillig procedure (4) with slight modifications (2). Results are expressed as percentage of lactic acid on the products reconstituted to normal milk.

Titratable acidity was determined on practically all of the dried milk but on only the summer samples for the evaporated milk. The acidity of the evaporated milk was determined by diluting the product with an equal volume of water and then titrating electrometrically using a Beckman pH meter and a Type E glass electrode. The titration involved the adjustment of the sample to pH 8.3 with N/10 NaOH.

The method used for measuring the titratable acidity of dried milk was essentially that recommended by the American Dry Milk Institute (1). This procedure involves the use of 5 grams of the sample in 50 ml. of water, mixing thoroughly and allowing to stand one hour. A 17.5 ml. sample is transferred to a titrating cup, the pipette rinsed out with 17.6 ml. of water, the rinsings added to the sample, and the sample then titrated with N/10 sodium hydroxide to the phenolphthalein end-point. The number of milliliters of sodium hydroxide divided by 20 represents the percentage of acidity.

TABLE 1—*Lactic acid content and titratable acidity of dried non-fat milk manufactured in Michigan*

Summer samples			Winter samples		
Sample No.	Lactic acid*	Titratable acidity	Sample No.	Lactic acid*	Titratable acidity
	(percent)	(percent)		(percent)	(percent)
1	0.039	0.162	1	0.012	.....
2	0.028	0.167	2	0.014	0.097
3	0.007	0.157	3	0.005	0.128
4	0.009	0.167	4	0.004	0.127
5	0.020	0.138	5	0.003	0.110
6	0.005	0.140	6	0.005	0.135
7	0.003	0.130	7	0.004	0.137
8	0.036	0.145	8	0.025	0.140
9	0.028	0.150	9	0.009	0.130
10	0.008	0.150	10	0.007	0.133
11	0.031	0.156	11	0.006	0.130
12	0.008	0.145	12	0.003	0.137
13	0.023	0.175	13	0.003	0.123
14	0.011	0.175	14	0.006	0.150
15	0.017	0.147	15	0.007	0.125
			16	0.012	0.135
			17	0.010	0.135
			18	0.006	0.130
			19	0.006	0.123
			20	0.015	0.145
Average	0.018	0.155	Average	0.008	0.130

*Values on basis of reconstituted samples.

TABLE 2—*Lactic acid content and titratable acidity of evaporated milk manufactured in Michigan*

Summer samples			Winter samples	
Sample No.	Lactic acid* (percent)	Titratable acidity (percent)	Sample No.	Lactic acid* (percent)
1	0.008	0.208	1	0.013
2	0.011	0.195	2	0.009
3	0.022	0.211	3	0.006
4	0.020	0.194	4	0.006
5	0.009	0.192	5	0.004
6	0.012	0.206	6	0.004
7	0.012	0.212	7	0.006
			8	0.005
			9	0.005
			10	0.004
			11	0.006
Average	0.013	0.203	Average	0.006

*Values on basis of reconstituted samples.

Results for the dried and evaporated milk are presented in Tables 1 and 2 respectively.

The lactic acid content of the dried milk varied rather widely between individual samples, with the variation being considerably greater in the summer samples. Of the 15 samples of summer milk, 9 or 60 percent exceeded 0.01 percent, and 6 or 40 percent exceeded 0.02 percent. In contrast, of the 20 winter samples of dried milk, 5 or 25 percent exceeded 0.01 percent in lactic acid, with only one sample exceeding 0.02 percent.

The titratable acidity of the dried milk also shows some differences between individual samples and between the samples from the different seasons. The titratable acidities of the summer samples mere, in general, somewhat higher than those for the winter samples. For example, none of the winter samples exceeded 0.15 percent acidity, whereas 6 or 40 perseasons. The titratable acidities of the summer samples were, in general, seasonal variations indicate a direct relationship between lactic acid and titratable acidity, such a relationship is not always revealed by the results on the individual samples. Some samples exhibited high titratable acidities and low lactic acid content, whereas the reverse occurred with other samples.

Although the small number of evaporated milk samples does not permit definite conclusions, the results indicate a seasonal variation in lactic acid content with the summer milk averaging approximately twice that of the winter milk. In general, however, the evaporated milk had somewhat lower lactic acid contents than the dry milk samples.

The higher titratable acidity of the evaporated milk in contrast to the dry milk may be expected, due to the production of acid by the sterilization process.

DISCUSSION

If the quality of concentrated milk products is to be determined to some extent by the lactic acid content, the establishment of lactic acid standards would seem highly desirable. The problem which arises, however, is to ascertain the level at which such standards should be established. Conceivably, such a level should be sufficiently strict to result in the exclusion of inferior milk, but not so strict as to create an illogical and unfair condition from the standpoint of the manufacturer.

Strictly fresh milk, analyzed by the Hillig method, will give values representing from 0.001 to 0.004 percent lactic acid. Such milk, when processed at high temperatures, may undergo changes resulting in further increases of lactic acid, probably not more than 0.002 percent. Thus, the total lactic acid content of evaporated or dried milk manufactured from fresh milk will likely not exceed 0.006 percent. If some tolerance is permitted for errors in technique and for slight but normal changes of lactic acid in the fresh or stored product, a standard either of 0.01 or 0.015 percent would appear to be not too extreme.

However, if a standard of 0.01 percent was established, the results herein presented indicate that there would be need of considerable improvement in the quality of the milk used in the manufacture of concentrated products. On the basis of the results in this study, 60 percent of the dry milk samples manufactured in the summer season exceeded this level. Of the winter samples, 5 of the 20 dry milk samples possessed lactic acid in excess of 0.01 percent.

Establishment of the somewhat more generous standard of 0.015 would appear to be more logical, at least insofar as the results of this study are concerned. Using such a standard as a basis for grading, all but two of the 18 evaporated milk samples and 19 of the 20 winter samples of dry milk would be acceptable. However, of the 15 summer samples of dry milk, 8 exceeded 0.015 percent in lactic acid.

CONCLUSIONS

Results are presented of lactic acid and titratable acidity measurements on 35 samples of dry milk solids (not over 1.5 percent fat) and on 18 samples of evaporated milk. The average lactic acid content of 15 summer samples of the dry milk was 0.018 percent, whereas the average for 20 winter samples was 0.008 percent. The average titratable acidities for the summer and winter samples were 0.155 and 0.130,

respectively. The lactic acid content for 7 summer samples of evaporated milk averaged 0.013 as contrasted with an average of 0.006 percent for the winter samples. A discussion is given relative to the possibility of establishing lactic acid standards for these products.

REFERENCES

1. American Dry Milk Institute, Inc. The Grading of Dry Milk Solids. 1936.

2. Gould, I. A. Lactic Acid in Dairy Products. I. Application of the Hillig Method. Jour. Dairy Sci., *27* (9) : 743-752. 1944.

3. Gould, I. A. and Jensen, J. M. Lactic Acid in Dairy Products. II. Relation to Flavor, Acidity Measurements, Bacterial Count and Methylene Blue Reduction. Jour. Dairy Sci., *27* (9) : 753-767. 1944.

4. Hillig, F. The Colorimetric Determination of Lactic Acid in Milk and Milk Products. Jour. Assoc. Off. Agr. Chem., *20:* 130-141. 1937.

MOW DRYING OF HAY

By S. T. DEXTER and W. H. SHELDON
Section of Farm Crops and Agricultural Engineering

Production of high quality hay, leafy and undamaged by the weather, has long been the aim of workers with forage crops. In the past few years, a program for curing hay in a new way has attained a considerable degree of popularity in Tennessee, Virginia, and other states of that region. In this system, wilted and partially cured hay is hauled into the mow where drying is completed by means of air blown through the hay with fans. Parallel bottomless tunnels, about 5 feet apart, made of ordinary lumber, are built on the mow floor. From a main tunnel, air is blown through these lateral tunnels from which it escapes and circulates up through the hay. In general, unheated air has been used, although excellent results from the supplementary use of artificial heat have been reported.

EXPERIMENTAL PROCEDURE

At Michigan State College in 1944, a mow 18 by 30 feet was equipped with such a system of tunnels and a fan delivering about 7,500 cubic feet per minute. This was driven by a 2-horsepower motor. Figure 1 shows the fan and motor, installed in a shed outside the barn. Figure 2 shows a view of the main tunnel with the side tunnels projecting from it along the floor. The main tunnel has the dimensions 3 by 4 feet; the small, 8 by 16 inches. In this experimental unit, instruments were installed for recording temperature in the hay and in the air, relative humidity of the air, and the pressure and velocity of the air. A time clock was used to start and stop the motor as desired during the last week of operation.

On June 14 and 15, a field of about 8 acres of a mixture of alfalfa and smooth brome grass was cut. It was raked on the afternoon of June 15, and morning of June 16. This very tough hay was put in the mow, starting the afternoon of June 15, and continuing until all the hay was in, by noon June 17. The first hay, put in about 24 hours after cutting, was extremely damp and heavy to handle. The next day it was down to about 38-percent moisture and could be handled much better. The last buckrake load had a moisture content of 31 percent

(Article 27-45)

Fig. 1. Centrifugal-type fan with 2-horsepower motor located in shed outside the barn.

and was almost fit to mow away, in limited quantities, in an ordinary mow. In all, the mow was filled in two days' time to a depth of about 14 feet. This hay finally settled to a depth of 10 or 11 feet. Figure 3 shows in diagrammatic form when the hay was put in, at what moisture content and tc what depth.

During the filling of the mow, the fan was run continuously night and day. After the mow was filled, the fan was run twice a day for a week to investigate the effect of accidental shutting off of power. The weather during this week was cool and humid. In the course of 6 to 12 hours, without the fan running, the hay usually heated up to a tem-

Fig. 2. The main tunnel, 3 by 4 feet, and six branch tunnels were built on the mow floor. The main tunnel was lined with building paper. The branch tunnels, open on the bottom, were held about an inch from the floor by cleats, as shown in the photograph.

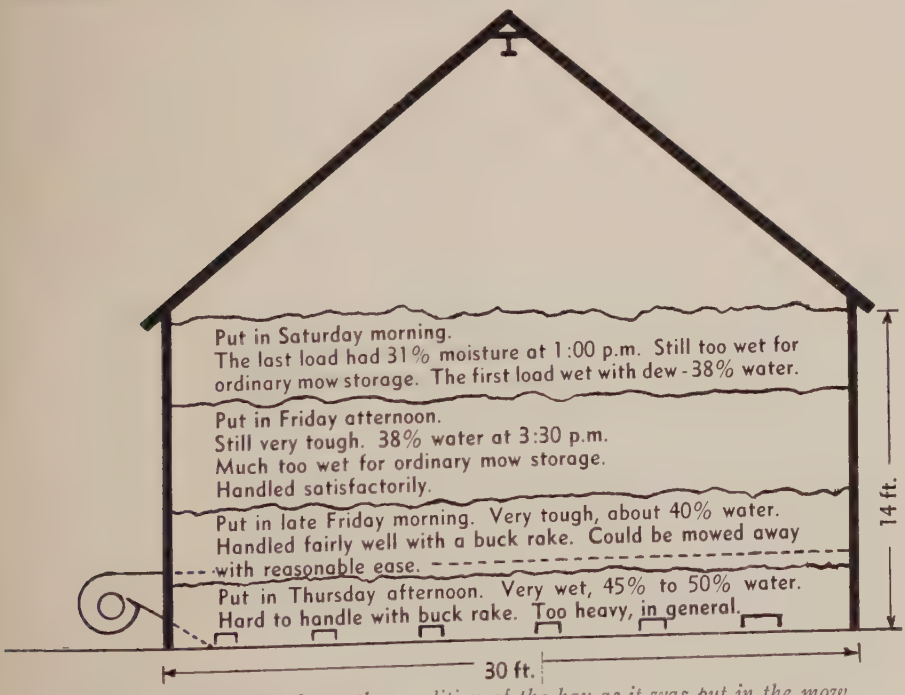

Put in Saturday morning.
The last load had 31% moisture at 1:00 p.m. Still too wet for ordinary mow storage. The first load wet with dew - 38% water.
Put in Friday afternoon.
Still very tough. 38% water at 3:30 p.m.
Much too wet for ordinary mow storage.
Handled satisfactorily.
Put in late Friday morning. Very tough, about 40% water.
Handled fairly well with a buck rake. Could be mowed away with reasonable ease.
Put in Thursday afternoon. Very wet, 45% to 50% water.
Hard to handle with buck rake. Too heavy, in general.
14 ft.
30 ft.

Fig. 3. This diagram shows the condition of the hay as it was put in the mow.

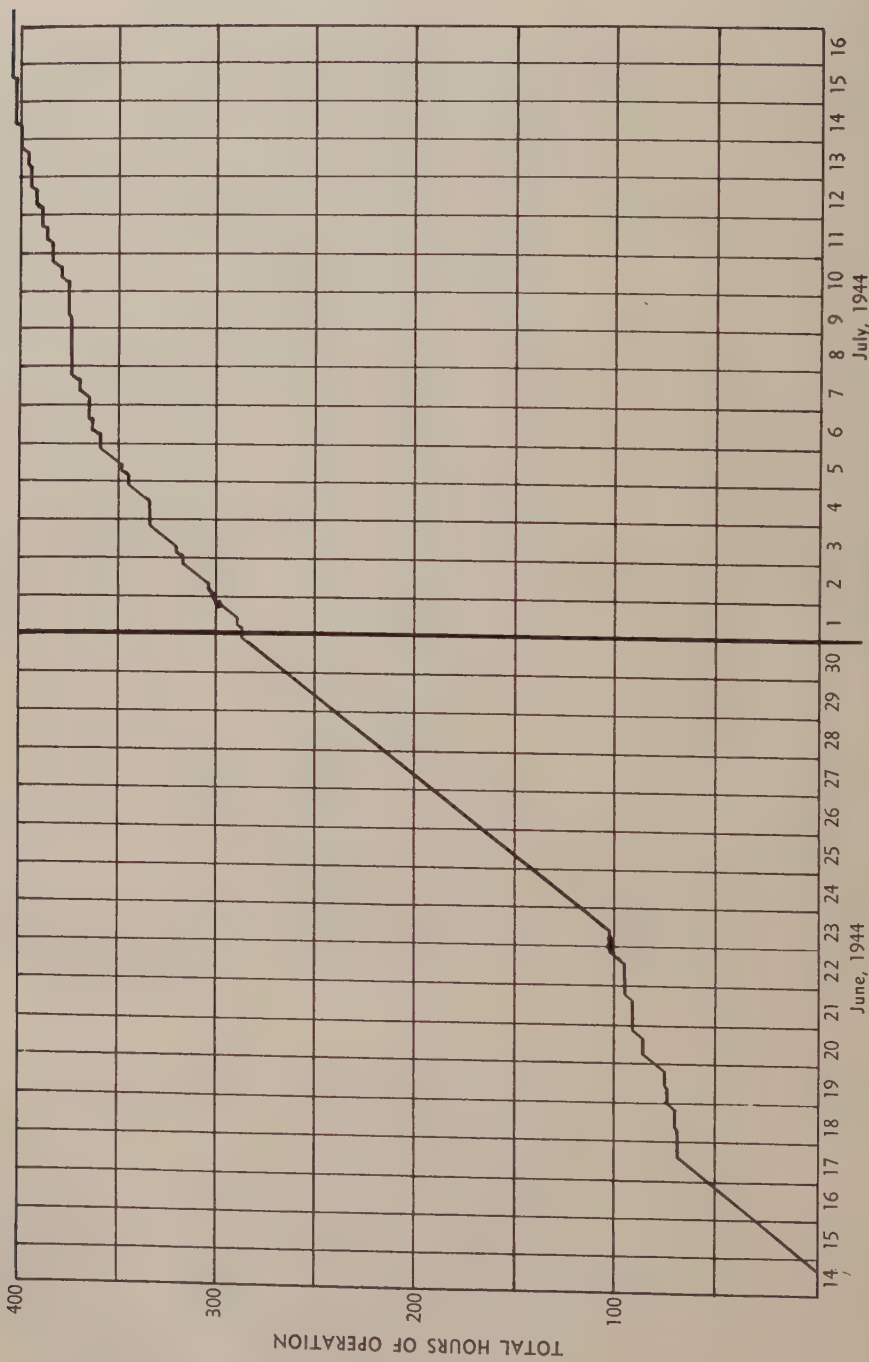


Fig. 4. Schedule and total hours of operation of the fan.

perature of about 100° F., but was cooled down to outside temperature within 3 hours by operating the fan. In general, the temperature of the hay when the fan was running was several degrees cooler than outside temperature, owing no doubt to the evaporation taking place in the hay. In the first week, the fan operated for a total of about 35 hours, thus indicating that the danger from accidental shutdown was slight.

It should be emphasized, however, that this is not a recommended practice. In general, experience has shown that operation should be continuous, night and day, except perhaps during rain.

From the operation of this system during the first week, the authors concluded that heating of hay can be prevented completely by blowing air through it. Furthermore, it seems wise to avoid heating because air which is blown through heated hay will absorb so much moisture that part of it may be deposited on the upper layers of the hay which are relatively cool. Hay wet with outside moisture seems to be a favorable place for the development of molds causing mustiness. After the first week of experimentation, the fan was run continuously for a week. No heating of the hay occurred and no condensation was evident upon the upper layers. Following this period, the fan was run intermittently with time-clock control. Fig. 4 shows the hours of operation of the fan throughout the entire drying period.

In all, the fan was operated about 400 hours. The consumption of electricity was 812 k.w.h. This would amount to approximately $1 a ton of cured hay at a rate of 2¢ per k.w.h. Under conditions that could be recommended in practice, this figure is probably too high, since much of this hay was put in the mow far wetter than could be recommended.

QUALITY OF HAY

In September, just before Farmers' Day at the College, a trench was cut from top to bottom through this hay, thus allowing a thorough examination of its quality. All farmers who examined this hay seemed favorably impressed by its high quality. That put in first, at a moisture of 45 or 50 percent, was of excellent quality. It was adjacent to the air tunnels, and dried most quickly. There were no moldy spots found in the hay taken out (perhaps ¾ ton). The upper 2 feet of hay was slightly musty. This portion when put in was very wet with dew and also had moisture condensed upon it, as described above, during the first week.

As a whole, the hay was of excellent quality. It was greener than ordinary field-cured hay, although in the heating that was intentionally permitted the first week, a good deal of color had been lost. The

leafiness of this hay was outstanding, since it was put in the mow before the leaves were dry enough to shatter.

This preliminary report indicates that such a system of curing hay may have great possibilities in Michigan. It saves the leaves, speeds up operations, and takes much of the uncertainty out of making hay. If the hay is handled at a moisture content of about 35 percent, that is, when the hay is still decidedly tough it handles much like dry hay, and yet retains its leaves. It is essential that the hay be mowed away promptly, since it settles very readily into a compact pile. If a mow were filled with a rapidity common on most farms, rather than in two days as in this case, it seems likely that depths of hay greater than 14 feet could readily be used. However, with this heavy hay which packed readily, about as much hay was actually put in the mow as could have been put in had the hay been field cured to the ordinary dry condition. Further experimentation is required before recommendations can be made for all types of storage in deep hay mows, but for many conditions, this system of curing seems highly practicable.

BULLETIN REVIEW

COMPILED BY NEWTON L. PARTRIDGE

Technical Bulletin 196

Management in Michigan Homes

Gross, Irma H., and Zwemer, Evelyn A.

A study in 1939-41 of 382 unbroken American families in 7 counties in Michigan. Half were farm and half village families; approximately one-third each were low, medium and comfort income levels. The sample also included definite proportions of different size and composition of families and different occupational groups. Managerial practices were investigated under the following heads: management of money, management of specific goods, household production, management of time and energy, and long-time family planning. (92 pp., 41 tables, 10 figs.)

JOURNAL ARTICLE ABSTRACTS

COMPILED BY NEWTON L. PARTRIDGE

Comparison of the Agglutinability of Several Brucella Antigens (Rapid Test)

BENNETT, GEORGE R.

Veterinary Medicine 39 (12): 455-456. [*Journal Article 525 (n. s.) from the Michigan Agricultural Experiment Station*]

A comparison of the agglutinating properties of several commercial Brucella Rapid Antigens. Each one was compared with the tube and rapid antigens employed in the Central Brucella Station. All antigens proved satisfactory when used according to the direction of the manufacturer.

Determining Ascorbic Acid in Large Numbers of Plant Samples

LUCAS, E. H.

Ind. and Eng. Chem. (Anal. Ed.) 16: 649-652. 1944. [*Journal Article 646 (n. s.) from the Michigan Agricultural Experiment Station*]

A procedure which materially speeds up the determination of ascorbic acid in plant samples with no increase in error is described. This is essentially a combination of a method published by Morell in 1941 with the indophenol titration as used in the method developed by Tillmans, Hirsch and Hirsch, subsequently improved by others. The use of a mechanical grinding device is suggested instead of the blender if the disintegration of very small or fibrous samples is desired.

The efficiency of the Waring blender and the grinding machine is compared with hand grinding. Filtration of the extracts was found to give essentially the same results as centrifugation and be much less time consuming. Data are presented that show that careful titration is no less accurate than colorimetric determination and is more rapid.

The Bacterial Oxidation of Corn Oil

MUNDT, J. O., AND FABIAN, F. W.

Jour. Bact. 48: 1-11. 1944. [*Journal Article 659 (n. s.) from the Michigan Agricultural Experiment Station*]

The ability of 32 widely distributed species of bacteria to oxidize a practically pure trigliceride without hydrolysis was determined by the Warburg apparatus. Studies were also made of their oxidizing

as compared to their reducing ability as measured by the Thunberg technic. An attempt was made to correlate the oxidation of corn oil with the following chemical tests: acid number, peroxide number, iodine absorption number, saponification number, refractive index, aldehyde number, Kreis test and the fatty acids in the residue.

The results showed that the Warburg apparatus was a dependable, time-saving instrument and yielded information not made available to date by cultural or chemical tests. It was found that of the 32 organisms studied, 25 showed an increased rate of utilization of oxygen while only 6 evinced the ability to dehydrogenate corn oil.

Previous to this work only one species, *Aerobacter aerogenes,* had been shown to be fat-oxidative and non-lipolytic. The data showed that not only *Aerobacter aerogenes* but also *Alkaligenes faecalis, Sarcina lutes, Micrococcus aurantiacus, Micrococci flavescens, Micrococci cinnabareus, Flavobacterium arborescens, Phytomonas tumefaciens* and *Pseudomonas mephitica* are fat-oxidative and non-lipolytic.

On prolonged incubation, the oxidative changes of lipids brought about in flasks containing bacteria are indistinguishable from strictly non-biological changes, as shown by determinations of the various fat constants. A concentration of 0.85 percent NaCl brought about a noticeable inhibition in the rate of respiration for three species of *Pseudomonas,* while a concentration of 2.5 percent inhibited the respiration of all species except *Pseudomonas fluorescens* in the presence of oil to a point below that of endogenous respiration in saline-buffer suspension. The respiratory rate is influenced by a decreased pH, but a comparatively low pH, biologically speaking, is required to bring about a noticeable inhibition. Two antioxidants, hydroquinone and Avenex, did not prevent bacterial respiration in the presence of oil in the concentrations used. The latter compound was utilized by four of the five species studied.

Effects of Soil Treatments on the Growth of the Highbush Blueberry

Merrill, T. A.

Jour. Agric. Research 69 (1): 9-20. 1944. [*Journal Article 670 (n.s.) from the Michigan Agricultural Experiment Station*]

In the soil under test, pH 3.2 was below the limit for vigorous growth of blueberry plants. Symptoms associated with too high acidity are leaf scorch, which begins at the leaf margins and progresses across the leaf finally resulting in defoliation. This may be followed by stunting and finally by death. Applications of lime sufficient to raise the pH of the soil from 3.4 to 3.8 prevented leaf scorch and nor-

mal growth resulted. A positive correlation was found between total growth of plants and total mg. of N and P in tops of plants grown in sand and between total growth of plants and N and K content of plants grown in muck. KCl should not be used on blueberries.

Production of Onion Seed from Wintered-over "Scallions"

BOWSER, PERRY; HEWETSON, F. N., AND BARRONS, KEITH C.

Seed World 56 (2): 12-13. 1944. [*Journal Article 702 (n.s.) from the Michigan Agricultural Experiment Station*]

Wartime seed shortage suggested the possibility of producing various cool weather vegetable crop seeds in Michigan. Among the problems involved in onion seed production were: time and rate of planting, suitable localities and growing sites, adaptable varieties and methods of winter protection. Onions sown in late June or early July were found to overwinter better than those sown earlier or later. Since summer planted onions seldom produce more than one seed stalk per plant, it is necessary to seed thickly enough so that plants are one to two inches apart. Adequate soil and air drainage was found to be essential for overwintering scallions satisfactorily. White Portugal, Ebenezer, Southport White Globe and the various strains of Yellow Globe were hardy enough under conditions of these trials to come through the winter in good condition. Utah Sweet Spanish, Early Grano, Yellow Bermuda, and Ailsa Craig were found too tender to be grown in this manner. Winter protection provided by hilling, use of mulches, snow fences and deep fences was found encouragingly successful. The area bordering Lake Michigan from Oceana county northward seems to provide dependable snow protection, a moderate winter temperature and a reasonably early harvest season to make a promising area for the production of onion seed by this method.

An Electrophoretic Study of Serum and Plasma from Normal and Leucosis-affected Chickens

SANDERS, EVELYN; HUDDLESON, I. FOREST, AND SCHAIBLE, P. J.

Jour. Biol. Chem. 155 (2): 469-481. 1944. [*Journal Article 712 (n.s) from the Michigan Agricultural Experiment Station*]

A comparative electrophoretic analysis by the moving boundary method has been made of the proteins in serum and plasma from normal chickens and from chickens affected with avian leucosis.

A new component, designated the L component, was found in serums from chickens affected with the several forms of leucosis. The new protein component had a mobility -2.55×10^{-5} cm.^{2} sec.$^{-1}$ volt^{-1} and represented approximately 10 percent of the total protein in the serum. There were no significant differences found in the electrophoretic patterns of serums that would distinguish any one type of leucosis from another.

The relative composition of the components in leucosis serum as compared with the normal showed a decrease in albumin and an increase in γ-globulin. The electrophoretic patterns in which the new component failed to migrate as a separate peak showed a very high concentration of γ-globulin. This fact would indicate a close relationship between the L component and γ-globulin.

A series of blood samples drawn from chickens at intervals after injection with an active transmissible tumor agent showed the presence of the L component as early as the third day. Chickens injected with the inactivated tumor agent also showed the presence of the L component but not until the fifteenth day after injection.

Attempts to separate the new protein component from γ-globulin by a salting-out method were unsuccessful.

The presence of the L component in the serum from leucosis-affected chickens may have immunological and diagnostic significance.

THE AGRICULTURAL EXPERIMENT STATION of MICHIGAN STATE COLLEGE

Postoffice and Telegraph address: East Lansing, Mich.
Railroad and Express address: Lansing, Mich.

DEPARTMENT OF THE MICHIGAN STATE COLLEGE, AND, WITH IT, CONTROLLED BY

INCORPORATED STATE BOARD OF AGRICULTURE

Hon. FOREST AKERS, Detroit	Term Expires Dec. 31, 1945
Hon. MELVILLE B. McPHERSON, Lowell	Term Expires Dec. 31, 1945
Hon. CLARK L. BRODY, Lansing	Term Expires Dec. 31, 1947
Hon. WILLIAM H. BERKEY, Cassopolis	Term Expires Dec. 31, 1947
Hon. WINFRED G. ARMSTRONG, Niles	Term Expires Dec. 31, 1949
Hon. SARAH VAN HOOSEN JONES, Rochester	Term Expires Dec. 31, 1949
Hon. JOHN A. HANNAH, President of the College	*Ex Officio*
Hon. EUGENE B. ELLIOTT, State Superintendent of Public Instruction, Lansing	*Ex Officio*
Hon. K. H. McDONEL, Secretary	

STATION COUNCIL

Anthony, E. L., M. S.	Dean of Agriculture
Gardner, V. R., M. S. A.	Director and Hort.
Giltner, W., D.V.M., M.S., D.P.H.	Bacteriology
Bessey, E. A., Ph. D.	Botany
Miller, E. J., Ph. D.	Chemistry
Schoenmann, L. R., B. S.	Conservation
*Patton, H. S., Ph. D.	Economics
Dye, Marie, Ph. D.	Home Economics
McKibben, E. G., Ph. D.	Agr'l Engineering
Hutson, Ray, M. S.	Entomology
Decker, R. E., B. S.	Farm Crops
Herbert, P. A., M. F., Ph. D.	Forestry
Hill, E. B., M. S.	Farm Management
Brown, G. A., B. S.	Animal Husbandry
Weaver, Earl, Ph. D.	Dairy Husbandry
Hallman, E. T., D. V. M.	Animal Path.
Card, C. G., B. S.	Poultry
Loomis, Charles P., Ph. D.	Sociology
Millar, C. E., Ph. D.	Soil Science
Hunt, H. R., Ph. D.	Zoology

ADVISORY AND ASSOCIATE STAFF

Wiant, D. E., M. S.	Res. Assoc. in Ag. Eng.
Branaman, G. A., Ph. D.	Res. Assoc. in An. Husb.
Cole, C. L., M. S.	Res. Assoc. in An. Husb.
Hudson, R. S., B. S.	Res. Prof. of An. Husb.
Clark, C. F., D. V. M.	Res. Assoc. in An. Path.
Sholl, L. B., M.S., D.V.M.	Res. Assoc. in An. Path.
Thorp, F., Jr., Ph. D.	Res. Assoc. in An. Path.
Bryan, C. S., Ph. D., D. V. M.	Res. Prof. of Bact.
Fabian, F. W., Ph. D.	Res. Prof. of Bact.
Huddleson, I. F., Ph.D., D.V.M.	Res. Prof. of Bact.
Mallmann, W. L., Ph. D.	Res. Prof. of Bact.
Stafseth, H. J., Ph.D., D.V.M.	Res. Prof. of Bact.
Cation, D., M. S.	Res. Assoc. in Plant Path.
Muncie, J. H., Ph. D.	Res. Prof. of Plant Path.
Nelson, Ray, Ph. D.	Res. Prof. of Plant Path.
Barr, C. G., Ph. D.	Res. Assoc. in Plant Phys.
Benne, E. J., Ph. D.	Res. Assoc. in Chem.
Duncan, C. W., M. S.	Res. Assoc. in Chem.
*Schaible, P. J., Ph. D.	Res. Prof. of Chem.
Dexter, S. T., Ph. D.	Res. Assoc. in Crops
Down, E. E., Ph. D.,	Res. Prof. of Crops
Harrison, C. M., Ph. D.	Res. Assoc. in Crops
Moore, H. C., B. S.	Res. Assoc. in Crops
Horwood, R. E., M. S.	Res. Assoc. in Dairy
Huffman, C. F., Ph. D.	Res. Prof. of Dairy
Lucas, P. S., M. S.	Res. Assoc. in Dairy
Trout, G. M., Ph. D.	Res. Prof. of Dairy
*Cline, D. C., Ph. D.	Res. Assoc. in Econ.
Ulrey, Orion, Ph. D.	Res. Assoc. in Econ.
McDaniel, Eugenia I., A. B.	Res. Assoc. in Ent.
Pettit, E. H., B. S.	Consulting Entomologist
Wright, K. T. Ph., D.	Res. Assoc. in Farm Man.
Stevens, T. D., Ph. D.	Res. Assoc. in Forestry
Gross, Irma H., Ph. D.	Res. Prof. of Home Ec.
Hawks, Jean E., Ph. D.	Res. Assoc. in Home Ec.
Ohlson, Margaret A., Ph.D.	Res. Prof. of Home Ec.
Barrons, K. C., M. S.	Res. Assoc. in Hort.
*Cardinell, H. A., B. S.	Res. Assoc. in Hort.
Marshall, R. E., Ph. D.	Res. Prof. of Hort.
Merrill, T. A., M. S.	Res. Assoc. in Hort.
Partridge, N. L., Ph. D.	Res. Assoc. in Hort.
Rasmussen, E. J., M. S.	Res. Assoc. in Hort.
Robertson, W. F., M. S.	Res. Assoc. in Hort.
Russell, C. E., M. S.	Res. Assoc. in Hort.
Wildon, C. E., M. S.	Res. Assoc. in Hort.
Baten, W. D., Ph. D.	Res. Prof. of Math.
Sykes, J. F., Ph. D.	Res. Assoc. in Physiology
Barrett, F. N., M. S.	Res. Assoc. in Poul. Husb.
Davidson, J. A., B. S.	Res. Assoc. in Poul. Husb.
Hoffer, C. R., Ph. D.	Res. Assoc. in Sociology
Honigsheim, Paul, Ph. D.	Res. Assoc. in Sociology
Thaden, J. F., Ph. D.	Res. Assoc. in Sociology
Bouyoucos, G. J., Ph. D.	Res. Prof. of Soil Sci.
Cook, R. L., Ph. D.	Res. Assoc. in Soil Sci.
Harmer, P. M., Ph. D.	Res. Prof. of Soil Sci.
Turk, L. M., Ph. D.	Res. Assoc. in Soil Sci.
Tyson, James, Ph. D.	Res. Assoc. in Soil Sci.
Veatch, J. O., A. B.	Res. Prof. of Soil Sci.
*Schneider, I. F., B. S.	Res. Assoc. in Soil Sci.
Wolfanger, L. A., Ph. D.	Res. Assoc. in Soil Sci.
Towne, J. E., A. M., B. L. S.	Librarian
Wilkins, C. O.	Treasurer
Geil, Lloyd H., M. A.	Head of Publications
Kutt, J. M.	Cashier
Knowlton, Lois A., B. S.	Bulletin Clerk

SUB-STATIONS

Chatham, Alger County, J. G. Wells, Jr., Superintendent.
South Haven, Van Buren County, Stanley Johnston, Superintendent.
Graham Station, Kent County, Walter Toenjes, Superintendent.
Dunbar, Chippewa County, Forestry Station, Maurice W. Day, Superintendent.
Lake City Experimental Potato Farm, Missaukee County, Ashley Berridge, Superintendent.

**On leave of absence.*

Agricultural Experiment Station
of the Michigan State College
East Lansing, Michigan

V. A. Gardner
Director

Free — Annual Report or Bulletin or
Report of Progress

POSTMASTER—If not delivered, PLEASE RETURN, giving reason for non-delivery. (See Postal Rules and Regulations, 1932, Sec. 622.)

Penalty or private use to avoid payment of postage
$300